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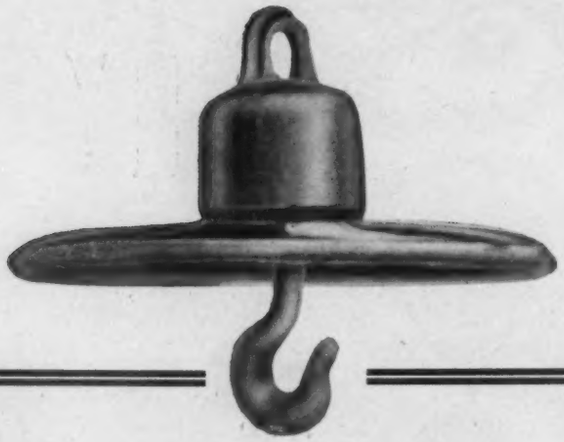

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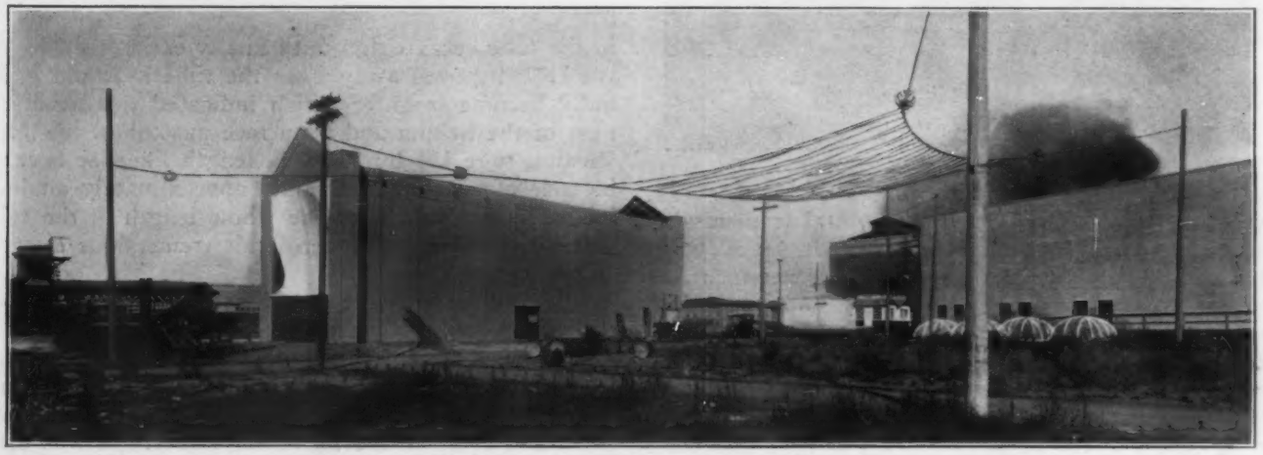
THE MILLION VOLT EXPOSITION TRANSFORMER

BY A. S. LINDSTROM.

While the million volt transformer at the Panama-Pacific International Exposition excited much popular interest during the closing days of the exposition, the engineer is more interested in what can be learned from these spectacular experiments. They had to do solely with electrostatic phenomena and gave helpful hints on methods of insulation and avoiding corona losses. Before describing the results, a brief description of the apparatus employed is in order.



Outdoor Network for High Voltage Electrostatic Experiments.

A million volt transformer was especially built by C. H. Thordarson of Chicago, for exhibition at the exposition and to demonstrate a number of theories on transformer construction. It consisted primarily of a 2200 volt primary winding and a million volt secondary winding with a silicon steel core, circulating oil being used as an insulating medium.

It was installed in a metal lined cement pit, placed in a special building erected by the exposition authorities. The building was constructed without nails, bolts running parallel to the million volt wires being used to hold the structure together. The magnetic frame of the transformer was made up of a large number of silicon steel sheets, every fifth sheet being especially separated by paper. The upper and lower horizontal yokes were 120 in. in length and held apart by 40 in. vertical legs. The horizontal yokes and vertical up-rights measured 16 in. by 16 in. in the cross section and were held together by channel and angle irons. The upper yoke angle irons were so constructed to hold the entire weight of the primary and secondary windings and paper insulated barrier tubes.

The primary winding consisted of a paper insulated cylinder of copper wire which measured 67 in. long, 23 in. inside diameter, and 28 in. outside diameter. This winding was made of 122 coils, each coil consisting of 44 turns of copper ribbon separated by two thicknesses of 6 mil paper. The copper ribbon was 20 mil by 281 mils, being equivalent to No. 12 copper wire. The coils were spaced one-quarter inch apart, two connected in series, forming a number of 2200 volt groups, the winding consisting of 61 groups in parallel. The connections between the two coils was connected to a heavy copper busbar running the entire length of the primary winding and thoroughly grounded to the frame and to earth. The grounding of the neutral acted as an electrostatic ground shield to prevent any static disturbances on the 2200 volt winding from the million volt coil.

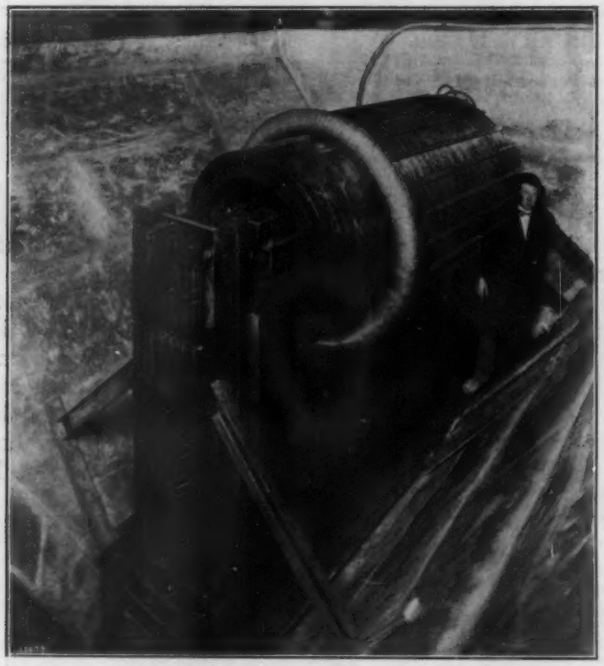
The main insulation barrier between the low voltage primary and the high voltage secondary was an insulating tube made up of paper impregnated in a hot insulating cylinder under vacuum. This tube was 92 in. long with internal diameter of 29½ in. and an external diameter of 41½ in., thus giving a thickness of 6 in.

The high voltage secondary consisted of 190 coils, 5300 volts, each connected in series. Each coil was made of 212 turns of aluminum foil, 8 mil by 135 mil

with three thicknesses of 6 mil paper between turns, thus forming a tube 71 in. long, 43 in. inside diameter and 51 in. outside diameter.

These 3 concentric tubes were placed in the metal lined cement pit and immersed in 225 barrels of transformer oil, loaned to the exposition by the Union Oil Company of California.

The high tension lead was brought out vertically through the oil to a height of 11 ft. and then connected by means of a 100 ft. horizontal transmission line to a square network of wires 50 ft. by 50 ft. in area and 30 ft. above the ground. This network was made of No. 12 iron wire with 3 ft. square spacing and was suspended by rope insulators from four 40 ft. cedar poles. Wire baskets were so connected at the four points of the electrostatic screen, where contact was made with the insulating rope, as to eliminate any undue stress at the point of contact of rope and wire. A safety rope net was placed 10 ft. above the lowest part of the screen and 20 ft. from the earth so as to protect the public from contact with any part of the wire screen in case the rope supports gave way. This arrangement constituted, in effect, a tremendous wireless telegraph station, the supports between the screen and the earth forming a condenser. The same transmission wire that connected the transformer with the electrostatic screen, was connected through an adjustable horn gap consisting of a ¾ in. pipe 15 ft. long, and thence to earth through a 12 ft. jet of water.



Million Volt Transformer in Vault.

With this arrangement many novel effects were brought out in nightly demonstrations of electrostatic phenomena. When a person standing under the screen held his hand in the air the finger tips would glow, and sparks could be drawn from an umbrella, hat or any metal object that was not directly in contact with the experimenter. An automobile drawn up near the influence of the wire screen, gave out sparks 1½ to 2 in. long. The metal parts of an umbrella gave out 2 to 3 in. sparks and at times, with a sudden surprise to the holder, a high voltage stress would puncture the handle of the umbrella. Helium and neon gas tubes became incandescent when within the influence of this field and the positive and negative lines of force could be clearly distinguished by their characteristic glow, the negative ions having a sharp bright line and the positive a broader and duller line. If one of these tubes was held so that it was slightly below the line of the shoulders of a number of observers gathered around, the field of force was lessened and the light in the tube became dim until finally extinguished. As the crowd moved away from the tube it would gradually become brighter which indicated the sensitiveness of the helium and neon rare gas tubes. A large vacuum tube 1½ by 30 in. in length likewise became incandescent and round nodes approximately an inch in diameter would form the whole length of the tube when within the influence of this tremendous electrostatic field.

Popular Electrostatic Demonstrations.

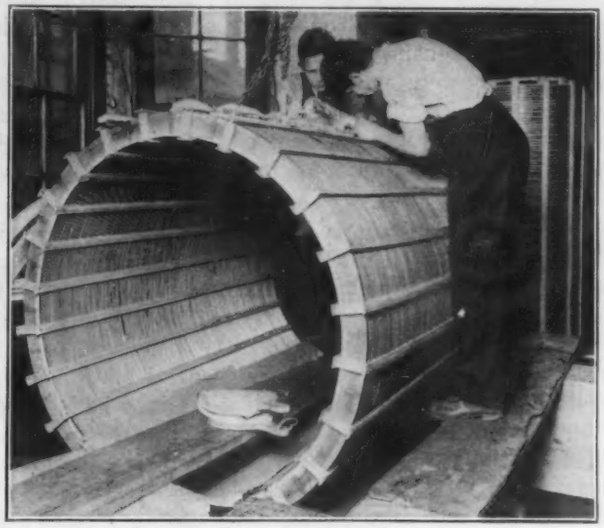
Heavy surges were occasioned in the operation of the transformer. One of these was so great that it broke down the insulating tube between the secondary and primary windings, and at the same time, an arc passed through 24 in. of oil, 1½ in. of plate glass and 1 in. of fine insulating paper. It was estimated that this miniature thunder and lightning display—for it was accompanied by a loud report—represented a surge of at least 4,000,000 volts, with about 450,000 volts impressed on the high voltage secondary and the spark gap discharging a pronounced visual corona so established for 8 ft. along the 100 ft. horizontal main conductor, the diameter being about 10 in. This fact would indicate that standing waves must have existed with potentials of 2 million volts when the electrostatic experiments were being tried out nightly.

Notwithstanding these tremendous voltages the transformer was never put out of commission for more than a few hours at a time by an accident. When the 15 ton transformer was removed from the pit, due to occasional leaks in the metal lining, it was handled readily by the 65 ton locomotive crane.

On one occasion, shortly after the locomotive crane had handled the transformer it became necessary to repair one of the million volt coils, as one of the turns had been displaced. The repair outfit consisted of a few dental tools, a piano spring adjuster

and a small surgical throat lamp, these tools being necessary to reach between the coils and strips of insulating paper between the turns. Small dental magnifying and straight mirrors were used to locate the trouble.

As has already been noted, the wire netting was supported by ropes upon which electrostatic shields were mounted. This rope was first impregnated with hot paraffin and while still warm was dipped in hot tar which formed a smooth coating over the outer surface of the rope and filled up the pores. This effective-

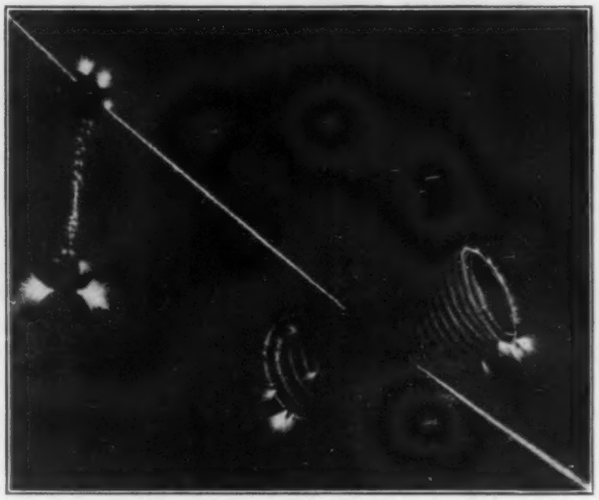


Connecting Coils.

ly prevented the entrance of moisture, even during the heavy rains which occurred while the experiments were being conducted. It is quite interesting to note that the rope supports which were used to take up the slack in the safety rope net, were burned off near the point of support. These small supports consisted of Stockholm tar ropes which for ordinary wireless work would be quite sufficient as insulating supports. The electro-static stress was so strong that it caused these ropes to burn off while the heavy million volt net supporting ropes held without any signs of burning, due, first, to the electrostatic shield where the rope came in contact with the wire, and, second, due to the rope being thoroughly impregnated so as to eliminate all moisture.

Electrostatic wire basket shields were located where the insulating rope made contact with the million volt wire. These shields were spread over the insulating rope a distance of 16 in., clearing the rope fully 8 in., which distributed the stress away from the rope, thereby avoiding the burning of the rope where it made contact with the line conductor.

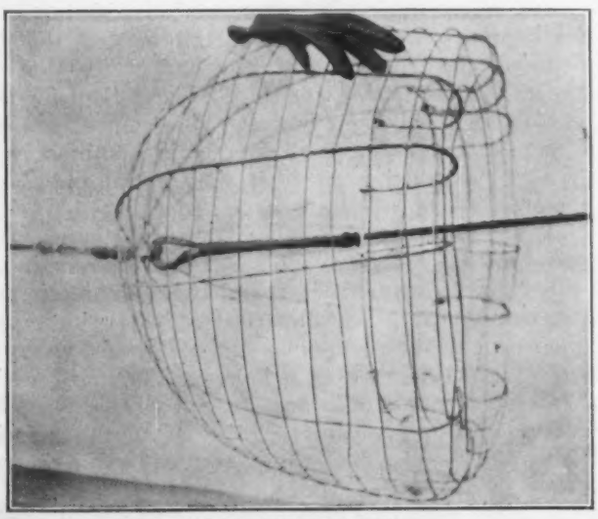
A new type of high voltage transmission line conductor was designated, which was, unfortunately, not



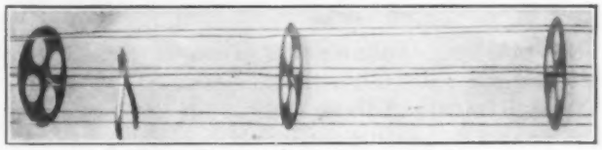
Corona Effects on Wire and Basket.

tried out in connection with the million volt transformer. This line conductor was to be made up of a number of wires running parallel and held apart by a metal disc 5 in. in diameter, and supported every 5 ft. by a much larger conducting wire threaded through the center of the disc. It is quite possible that this new line conductor will greatly eliminate corona and dampen surges so common on the transmission lines of today, the surges being dissipated in a great number of local short circuits which form between the heavy center supporting wire, out through the discs and along the small outside wires which are held apart by the disc.

From these experiments it has been proven that



Wire Basket Shield.



New Form of Line Conductor.

it is quite possible for this type of bare ribbon conductor and paper insulated transformer construction to be applied to regular power distributing systems. The expense of tapping a 33,000 volt distributing line for 50 kw., would be less than $695. This includes the taps from the high tension line the fused-switches and the installation of the transformers complete on a two-pole supporting structure up to the 110-220 or 440 service wires, the two-pole structure being set between the towers or poles of the transmitting line. This new transformer construction is provided with heavy rings for the inside and outside of each coil, which will

allow in cases of extraordinary high surges, the arcing between coils thereby blowing the fuses and clearing the transformers from the line.

From the number of tests made, the windings are not affected in the least and the transformer is ready for service on replacement of fuses. There will not be any interruptions on the main transmission line, as each installation will take care of its own troubles and the multiple series windings on these transformers are provided with grounded electrostatic shields, thereby protecting the property or lives of the consumers. This extends the range of transmission with such voltages and small consumers may be served in isolated sections, which will allow for a greater reduction of cost for lines and equipment.

Such a system could be greatly extended and will make possible the extension of power lines through sections of country that are now prohibitive on account of high cost of tapping and the great danger of consumers' lines being charged with high voltages.

On the last night of the exposition the transformer conductor wire was connected to ground through a ¾ in., 70 lb. pressure stream and this resulted in a very effective and beautiful display, as the stream of water was quite luminous with corona showing very distinctly. The surges must have been tremendous on the transformer as bolts of fire shot in all directions under the oil and literally chewed the end of the fibre pieces and that part of the paper tube which was directly under these pieces. At no time during this last night's test did the coils show signs of breaking down, which goes far to show the practicability of this construction being adapted to regular high voltage power work.

This 15 ton, thousand kilowatt, million volt transformer has been returned to Chicago at which place Mr. Thordarson proposes to set it up in connection with a number of very important experiments which he expects to conduct during the spring and summer months. Due to the very short time remaining after the arrival of the transformer at the exposition, it gave very little opportunity to carry on the research work which was proposed during the early part of the exposition, but now that the transformer is at Chicago this work, in addition to other experiments, will be carried on without taking up time for public demonstrations.

Prohibiting capitalization of power sites acquired by lease under the terms of the Ferris Bill would meet the requirements of those supporting the measure and remove the objections of those opposing it.

Maintenance of resale prices is endorsed by the majority of the special committee of the Chamber of Commerce of the United States. A properly regulated system of price maintenance on identified merchandise puts the emphasis in competition on quality and service and also provides adequate protection against extortion. It provides an incentive to invent and devise new products and serves to prevent monopolistic control of production processes by powerful distributors. It preserves individual enterprises and best serves public interest. The Chamber's board of directors has voted that the report be submitted to referendum.

WESTERN PRE-EMINENCE IN HYDROELECTRIC DEVELOPMENT.

A large part of the report of O. C. Merrill, chief Engineer of the U. S. Forest Service on "Electric Power Development in the United States and Concentration in Its Ownership and Control" (as furnished to the U. S. Senate by the Secretary of Agriculture) is devoted to hydroelectric conditions in the West.

The minimum potential water power resources of the United States are given as 27,943,000 h.p., and the maximum as 53,905,000 h.p. Over 72 per cent of this is found in the Mountain and Pacific states. Nearly one-half of the total or 42 per cent is found in the three states, Washington, Oregon and California. Of the water powers within the National Forests, 99¾ per cent are found in the Western states, and these powers amount to 42 per cent of the minimum and 43 per cent of the maximum estimated power resources of those states.

The total primary power under development in the United States in 1912 in commercial and municipal central stations, street and electric railways and in manufacturing plants, as estimated and reported for the year was 30,448,246 h.p., 22.9 per cent of this amount was used in commercial central stations—the public utility business. Municipal stations had 1.8 per cent and electric railways 12.1 per cent. Nearly two-thirds of the total or 63.2 per cent was used in manufactures.

Sixteen per cent of the total primary power in 1912, or 4,870,320 h.p. was water power of which nearly one-half was used in commercial central stations.

The reported and estimated steam installation for the United States in 1912 was 24,339,819. h.p., 80 per cent of the total power from all sources. Two-thirds of the steam power was used in manufacturing; about one-fifth in commercial central stations, one-eighth in street and electric railways and less than 2 per cent in municipal stations.

In the eleven Western states included within the Pacific and Mountain groups, primary power installation from all sources and for all uses increased 240 per cent from 1902 to 1912 or more than two and a half times as rapidly as in the remainder of the United States. In primary power equipment per capita the Western states during the same period added nearly twice as much to their total installation as the remainder of the United States and had an installation at the end of the period one-third greater than for the remainder of the United States. This comparison includes primary power used directly in manufactures, 94 per cent of which is found in the Central and Eastern states.

If a comparison is made of the development of electric power in the Western states and the remainder of the United States, it is found that while primary power employed in the electrical industry increased 226 per cent in the remainder of the United States, in the ten years 1902 to 1912, it increased 440 per cent in the Western states, or nearly twice as rapidly, while the development per capita in the Western states in 1912 was two and a half times as great as in the remainder of the United States.

If water power be considered apart from all other sources of power, the Western states are found to

occupy a still more commanding position. While water power development in the remainder of the United States increased 98 per cent from 1902 to 1912, it increased 451 per cent in the Western states or more than four and a half times as rapidly. In installed water power per capita the Western states in 1912 had more than four times as much as the remainder of the United States.

An examination of the data collected since the census of 1912 shows that the Western states are still maintaining their commanding position in power development. Primary power installation in the electrical industry in the Western states has increased nearly 47 per cent in the three years since 1912. The average annual increase has been 296,000 h.p. as compared with 191,000 for the five years 1907 to 1912. Three-fourths of the total increase is water power, in which the average annual additions for the last three years have been approximately twice as great as the average for the preceding five years.

Of the 1,800,000 water horsepower developed in the Western States in 1915, 30 per cent is in plants occupying National Forest lands with some part—power house, water conduit, or diversion reservoir—of the immediate generating plant.

In addition to the operating plants, there are now under construction on the National Forests hydroelectric plants with an estimated capacity at minimum stream discharge of 123,000 h.p. Outstanding final permits authorizing the occupancy and use of National Forest lands for hydroelectric plants, the construction of which has not yet started, aggregate 420,000 h.p., and preliminary permits, maintaining the priority of applicants while surveys and investigations are being conducted, aggregate 354,000 h.p.

THE SENATE WATER POWER BILL.

The Ferris water power bill, as passed by the House of Representatives, was struck out in its entirety as reported to the United States Senate and an amendment reported on January 25, 1916, whose more important provisions are given in extended summary as follows:

The Secretary of the Interior is authorized, under general regulations to be fixed by him, to lease any part of the public lands of the United States for a period of fifty years, for the purpose of constructing, maintaining and operating works necessary to the development of hydro electric power, which leases shall be irrevocable except as herein provided, but which may be declared null and void upon breach of any of their terms.

The Secretary may grant preliminary permits for a period not exceeding one year; provided, that no lease shall be granted until the applicant has complied with the requirements of the laws of the state, states, or territory wherein said project is to be located, providing for the appropriation of water to develop or generate the electrical energy intended to be generated by applicant's proposed project.

In case of the development or use of power in a territory, or in two or more states, the regulation and control of service and of charges for service to consumers is conferred upon the Interstate Commerce Commission.

"Sec. 5. That upon not less than three years' notice, the United States shall have the right upon the expiration of any lease to take over all the properties which are dependent in whole or in part for their usefulness on the continuance of the lease herein provided for, which may have been acquired by any lessee under the provisions of this Act, or the right to take over, upon mutual agreement with the lessee, a severable and complete unit of any such power system, upon condition that it shall pay in a lawful warrant drawn on the Treasury of the United States, or otherwise, before taking possession the fair value of such property, such value to be determined by mutual agreement between the Secretary of the Interior and the lessee, and, in case they cannot agree, by proceedings instituted in the United States district court for that purpose; provided, that such fair value shall not include or be affected by the value of any public lands, rights of way, franchises, or other property leased or granted under this Act by the United States, or by the good will, or prospective revenues."

In the event the United States does not take over the properties, the Secretary is authorized to lease the properties of the original lessee to a new lessee upon such terms, under such conditions, and for such periods as applicable state or federal laws may then authorize, and upon the further condition that the new lessee shall pay for the properties as provided in section five of this Act.

"Sec. 7. That where the public interest requires or justifies the execution by the lessee of contracts for the sale and delivery of electrical energy for periods extending not to exceed twenty-five years beyond the fifty-year period herein named, such contracts may be entered into upon the approval of the public service commission or similar authority in the state, and upon the approval of the Secretary of the Interior."

"That for the occupancy and use of lands and other property of the United States permitted under this Act, the Secretary of the Interior is authorized to specify in the lease and to collect charges or rentals for all land leased, which charges or rentals may in the discretion of the Secretary be measured by the power developed and sold or used by the lessee for any purpose other than the operation of the plant, and of the proceeds fifty per centum thereof shall be paid by the Secretary of the Treasury after the expiration of each fiscal year to the state within which the hydroelectric energy is generated and developed. The remaining fifty per centum shall be paid into, reserved, and appropriated as a part of the reclamation fund." Leases for the development of power by municipal corporations for municipal use shall be issued without rental charge and leases for development of power not in excess of twenty-five horsepower may be issued to individuals or associations for domestic, mining, or irrigation use without charge.

A "wire-your-home" campaign is to be co-operatively conducted throughout the country from March 15 to April 15, 1916, under the auspices of the Society for Electrical Development. It is stated that not 8 per cent of the homes in this country are wired for electricity and that not 20 per cent of the houses on the existing lines of the central stations have electric service.

Heat transmission through boiler tubes is accomplished by radiation, conduction and convection, the last being the most important in modern steam boilers. As the result of a series of investigations Henry Kreisenger and J. F. Barkley conclude in Techincal Paper 114 of the U. S. Bureau of Mines that the temperature of the boiler tube is within 10 to 20 degrees C. the same as that of the boiler water. As long as the heating plate is free from scale, oil or other deposits the metal of the boiler tubes can not be overheated, even though the boiler is worked at several times its rated capacity.

THE DIESEL ENGINE IN PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

Commercial Situation.

The commercial situation of the Diesel Engine is unique, for economical and reliable as the engine is, it will not answer, economically, for all possible needs. The matter of first cost and interest on this fixed charge, together with the retirement of the principal by depreciation or placing a certain sum aside to retire the whole cost of the installation in a given number of years all must be given their full consideration. To call the Diesel engine a "cure-all" is a mistake and it hurts the entire Diesel situation. If after making an extravagant statement the facts prove otherwise the engine and engines as a whole are discredited. Fuel economy is not the whole story in the economical generation of power, for the matter of fixed charges and the relative cost of coal and oil must be weighed impartially. It is questionable if the Diesel is suitable to a territory served by an electric transmission system having a diversified load factor composed of many different industries with maximum demands for power at different times of the day and at different times of the year. Such a system can offer inducements of low rates to the character of load to which the Diesel is most suited that need careful consideration. In certain industries where the load factor is high or the ratio of the average load to the maximum demand is high, such as with ice plants where the ice machines are operated 24 hours per day over the large part of the year, the Diesel engine shows its superiority and can compete with any type of power and show a saving.

A simple example can be cited. Suppose an ice plant having a capacity of 50 tons of ice in 24 hours is considered and the cost of power only is analyzed, the engine of approximately 150 or 160 h.p. will cost about $12,000 set up ready to operate. Let interest and depreciation be figured at 13 per cent per annum which is enough to retire the whole cost in ten years. This 13 per cent amounts to $1560 per annum or $4.33 per day. To this must be added the cost of fuel, considering that the engine is of the four-stroke-cycle type and is delivering its full 160 h.p. for 24 hr. each day. The fuel consumption is .41 lb. per b.h.p., or .41 × 160 h.p. × 24 hours = 1574 lb. Assuming that a barrel of oil costs $1 and weighs 315 lb. the number of barrels will be 1574/315 or approximately five barrels, or $5 per day for fuel. Lubricating oil may be guaranteed to be 1/10 of a gallon per hour, at a price ranging from 30 to 40 cents per gal. This will amount to 24×.40/10=96 cents per day. In an ice plant it would be difficult to justly apply the cost of labor exactly where it belongs. If the ice machine were operated by electric motors the cost of labor would be as great as if the plant were operated by the Diesel engine and less with the Diesel engine than with steam driven ice machinery. For convenience let us divide the cost of labor in half, charging half to the power and half to the actual manufacture of ice. There would be required in such a plant as we are considering a chief engineer and two assistants, the chief taking at least a part of the 24 hour operation for his watch, salary of the chief engineer $1500 per year or $125 per month, and two engineers at $100 per month, or a total labor charge of $325 per month, or $10.83 per day, a half of which, or $5.42 to charge against the cost of power. A charge must also be made for engine room repairs, such as new valve packing, gaskets, springs, emery, etc., of $150 per year or approximately 50 cents per day.

To recapitulate: Cost per day of 24 hours,

Interest and depreciation	$4.33
Fuel	5.00
Lubricating oil	.96
Labor	5.42
Sundries	.50
Total	$16.21

The output of this plant is 50 tons of ice per 24 hours, making a cost per ton of ice for power 32 cents, including all charges.

Comparing this with an electric motor driven plant using the same size ice machine it would require a 160 h.p. motor with an imput of 133 kw., assuming 90 per cent motor efficiency, or 3200 kw.-hr. per day of 24 hours. At 1 cent per kw.-hr. this would amount to $32.00; at ½ cent per kw.-hr. $16 per day. To this must be added $5.42 per day for labor, making $37.42 and $21.42 respectively, the total cost of power per day. This shows the saving by using a Diesel engine with this type of service amount to $21.20 per day with current at 1 cent per kw.hr. and $5.20 with electricity at the ½ cent rate.

If, however, the yearly load factor should be only 50 per cent, or in other words the plant should be run for only six months and shut down completely for the balance of the year the apparent Diesel saving would be materially reduced, for $16.21 × 182 days of operation = $2950 cost during the time the plant is in operation, but during the balance of the year the interest and depreciation continue and there must be in addition a charge of $4.33 × 182 days or $790 fixed charges, making a total of $3740 per year. While with electric power the cost would be entirely proportionate to the number of days' operation, the fixed charges on the electrical apparatus, which would cost approximately $1000, being wholly inconsiderable. With power at 1 cent and ½ cent per kw.-hr. the cost of power would be $37.42 × 182 = $6810.00 and $21.42 × 182 days = $3900 respectively.

The above gives a clear conception of the great effect of load factor on the total cost of power. In other words, fixed charges, interest, depreciation, insurance and taxes go on day and night regardless of whether the plant is being operated or not. A far more marked example may be assumed where labor joins fixed charges and must be retained whether or not the apparatus is doing the full useful work, for instance, in an electric light plant where 24 hr. service is maintained and during part of this time but an exceedingly small load is carried.

In comparison with a steam turbine the Diesel engine will cost considerable more to install, but the total cost of operation, including fixed charges labor, fuel, lubricating oil and maintenance may be considerably less with the Diesel if the load factor is between 25 per cent and 50 per cent.

The following comparison is interesting: Assume a plant consisting of one 200 kw. unit and one 400 kw. unit, a total capacity of 600 kw., having a load factor of 25 per cent, oil to cost $1 per barrel. The steam turbine plant erected would cost approximately $50,000 while the Diesel engine would cost $73,000. These costs would include building and all necessary apparatus in connection with each of the installations. Operating at 25% load factor the average load per hour would be equivalent to 125 kw. or the load per year would be 125 kw. × 365 days × 24 hours, or 1,100,000 kw.-hr. A steam turbine plant of this size may be assumed to develop 190 kw.-hr per barrel of oil, while a Diesel engine plant will develop 100 kw.-hr. for every 9 gal. of oil, or 466 kw. hr. per barrel. The number of barrels per year for the steam turbine will be 1,100,000/190, or 5800 barrels; for the Diesel engine the consumption per year will be 2360 barrels. The fixed charges of 14 per cent on the installation cost on both Diesel and turbine plant, including the boilers, the life of the turbine plant being equal to the life of the Diesel engine, will amount to $7000 per annum on the steam turbine plant and $10,220 per annum for the Diesel engine, the total of fuel and fixed charges in the case of the turbine being $5800 and $7000 = $12,800 per annum. With the Diesel engine fuel cost $2360 in addition to $10,220 = $12,580. The wages in the Diesel engine plant will be less than those in the steam turbine plant but the lubrication of the Diesel engine will be slightly in excess of that of the steam turbine. The maintenance, including boiler and turbine, will be greater on the steam plant than on the Diesel engine. The cost for water on the steam plant will be in excess of that of the Diesel engine and it would be difficult in any ideal case as we have assumed, to compare any of these figures, as they so greatly depend upon the locality of the plant, but neither type of prime mover will have any distinct advantage over the other in these regards.

From the above comparison of the cost of fuel and fixed charges the Diesel has so slight an advantage over the steam turbine at 25 per cent load factor that the case alone would not indicate the choice of prime mover. However, as the load factor increases the advantage of the Diesel becomes more apparent and with 50 per cent load factor the following is the result:

The fuel cost of the steam turbine	$11,600
Fixed charges	7,000
Total	$18,600
With the Diesel, fuel charge	$ 4,720
Fixed charges	10,220
Total	$14,940

This is a saving of approximately $4000 per year over the cost of operation of the steam turbine plant. It will be noted that the fixed charges remain constant and the fuel charges increase, making the Diesel continue to show an economy as the load factor increases and even as it decreases between from 50 per cent toward 25 per cent the advantage will still be with the Diesel. At the 50 per cent load factor it will be noted that the $3600 per year saving represents almost 5 per cent on the total cost of the Diesel installation or the saving on the Diesel would return the difference in cost over a steam turbine plant in approximately six and one-half years.

It will also be noted from this analysis that the advantage of the Diesel increases with an increase of price of oil, for the item of fuel consumption would increase in each case for both the steam turbine and the Diesel, but more so with the steam turbine where the fuel consumption is at a greater rate.

But there enters here the consideration of the consumption of coal, so again the situation must be looked into for the special locality of the proposed installation. All problems of the installation of a Diesel engine revert to fixed charges or the value of the money invested, and in each case must be analyzed on its merits. Where oil is expensive and coal cheap another problem presents itself and again the load factor will undoubtedly be the determining issue. In a comparison with a steam plant using Corliss engines the Diesel can show a saving at lower load factor than when compared with steam turbines, although the fuel consumption for a steam engine plant may be slightly better.

Plant Load.

	Time.	Average Load.	Total Load.	
A.	1 a.m. to 5 a.m.	90 kw.	360 kw.-hr.	
B.	5 a.m. to 7 a.m.	110 kw.	220 kw.-hr.	
C.	7 a.m. to 8 a.m.	220 kw.	220 kw.-hr.	
D.	8 a.m. to noon	170 kw.	680 kw.-hr.	
E.	noon to 1 p.m.	50 kw.	50 kw.-hr.	
F.	1 p.m. to 5 p.m.	170 kw.	680 kw.-hr.	Av. load, 141 kw.
G.	5 p.m. to 6 p.m.	300 kw.	300 kw.-hr.	
H.	6 p.m. to 9 p.m.	150 kw.	450 kw.-hr.	
I.	9 p.m. to 11 p.m.	110 kw.	220 kw.-hr.	
J.	11 p.m. to 1 p.m.	100 kw.	200 kw.-hr.	
			3380 kw.-hr.	Per av. day, 24 hr.

eak load say 315 kw.

Diesel Plant.

Diesel Engine Plant, consisting of 2-240 b.h.p. Diesels, each with a 160 kw. direct coupled generator.

Period.	Engines running.	Load on each kw.	Fuel per kw.-hr. lb.	Fuel Gal., per 100 kw.-hr.	Total fuel gal.	Engine hr.
A.	1	90	.64	8.9	32.0	4
B.	1	110	.62	8.6	18.9	2
C.	2	110	.62	8.6	18.9	2
D.	2	85	.65	9.1	61.8	8
E.	1	50	.83	11.6	5.8	1
F.	2	85	.65	9.1	61.8	8
G.	2	150	.62	8.6	25.8	2
H.	2	75	.68	9.5	42.7	6
I.	1	110	.62	8.6	18.9	2
J.	1	100	.63	8.8	17.6	2
					304.2	37
Add 8 per cent for ordinary conditions					24.3	2.5
					328.5 (Gal. fuel per day.)	39.5 (Call 40 hr).

Fuel oil at $1.50 per bbl. delivered, $150/42 3.67c gals., or $12 per day.

Labor—1 man at $100 mo.; 1 at $80; 1 at $60 = $240 mo. = $8.00 per day.

Lubrication—1¼ pints per engine hr. (40 eng. hr.) = 6¼ gal. per day. At 32c per gal. delivered = $2.00 per day.

Water—At 65° to 75° F. = 1500 gal. per eng. hr. = 60,000 gal. per day. Cost of pumping—2c per 1000 gal. = $1.20 per day.

Maintenance—$300 per annum per engine.
25 per annum per generator.

$325 × 2 = $650, all running 24 hr. day (48 eng. hr. day). Actual only 40 hr. per day.

$$\frac{650}{365} \times \frac{40}{48} = \$1.50 \text{ per day.}$$

Operating Expenses—Diesel Plant.

	Per day.
Lubricating oil	$ 2.00
Labor	8.00
Fuel	12.00
Water (pumping cost)	1.20
Supplies	.50
	$23.70 or .702c per kw.-hr.
Maintenance	1.50
	$25.20 or .746c per kw.-hr.

Total operating expense per annum, $25.20 × 365 = $9200.

Plant Cost—2 Diesels and standard equipment; Piping and Sundry; 1 Oil Storage Tank—12,000 gal.; 2 Generators; 1 Switchboard; Station Wiring; Foundations, 120 yd.; Erection. Approximately, $41,400.

Interest, depreciation, 13 per cent = $5382 per annum = $14.77 per day.

Operating	$25.20
Fixed charges	14.77
Total cost per day	$39.97

Or, $39.97/3380 = 1.18 cents per kw.-hr total expense.

Steam Plant.

Consisting of 2-200 I.H.P. compound condensing Corliss engines, each with 140 k.v.a. generator; 100 r.p.m.; 3-100 h.p. boilers.

Total constant loss, 45 I.H.P. each engine due to mechanical efficiency of engine, generating efficiency, including friction and windage losses.

Period.	Engines running.	Load in elec. h.p.	I.H.P. (El. H. P. and 45 h.p. loss).	Engine hr.	H.P. hr.	Total dry steam to engines.
A.	1	120	165	4	660	9510
B.	1	147	192	2	384	5530
C.	2	295	385	1	385	5540
D.	2	227	317	4	1268	18250
E.	2	67	157	1	157	2720
F.	2	227	317	4	1268	18250
G.	2	402	492	1	492	7330
H.	1	201	246	3	738	11000
I.	1	147	192	2	384	5530
J.	1	134	179	2	358	5160
Test conditions					6094	88820
Add 8 per cent for ordinary conditions						7100
						95920 = 15.75 per hp. hr.
Add 3 per cent leakage and condensation, 10 per cent auxiliaries and oil burners						12480
Total steam for boiler						108400 (Per day)

Fuel—Actual evaporation, 121 lb. water per. lb. fuel oil.
Fuel per day—108000 ÷ 121 = 9000 lb. = 1250 gal. (3.85 times as much as Diesels).

Fuel at $1.20 per bbl.—2.86c per gal. = $35.75 per day.

Labor—2 licensed engineers at $125 mo. each; 2 oilers at $2.00 day each; 2 firemen at $2.00 day each—$490 mo. = $16.33 per day.

Water—Boiler feed taken from condenser.
Condensers taking 25 to 1 condensing water.

$$\frac{95920 \times 25}{8.3} = 288{,}000 \text{ gal. per day.}$$

At 2c per 1000 gal. pumping cost = $5.76 day.

Maintenance—Boilers 200 h.p. running at $1.50 per h.p. ..... $300 per annum.
Auxiliaries ..... 125 per annum.
Engines and generators ..... 175 per annum.
$700 = $1.92 per day

Operating Expenses—Steam Plant—

Labor	$16.33	per day.
Fuel	35.75	
Lubricating oil	1.37	
Water	5.75	(pump'ng cost)
Supplies	.75	
	$59.96 ÷ 3380 = 1.77c	per kw.-hr.
Maintenance	1.92	
	$61.88 ÷ 3380 = 1.83c	per kw.-hr.

Total operating expense per annum $61.88 × 365 = $22,600.00

Comparison—Annual operating expenses, Diesel..... $ 9,200.00
Annual operating expenses, steam..... 22,600.00

Difference in favor of Diesel $13,400.00 per annum or 2½ times the total interest and depreciation on Diesel plant.

Or, the cost of current with steam engine for operation alone exceeds the total cost of current with the Diesel.

Steam Plant Equipment.

2-200 h.p. Cross compound condensing Corliss Engines for direct connection to alternator; 100 r.p.m.; for 150 lb. ga. pressure and 24 vacuum ref'd to 30 Barometer.
2-140 k.v.a, 80 per cent P.F., 60-cycle, 3-phase, 2300-volt, 100 r.p.m., Eng. type generator.
2 belted exciters for same.
2 jet condensing equipments, complete for above engines suitable for 24 in. vacuum ref'd to 30 Barometer, with water at 70° F.
3-100 h.p. (1000 sq. ft. heating surface) boilers, complete with all trimmings.
1 oil burning equipment complete for above boilers.
2-200 sq. ft. closed heater.
2-50 g.p.m. feed pumps .
All station piping.
2-12000 gal. oil storage tanks.

This comparison is a most rigid one, showing a lighting and power load, the Diesel plant consisting of two engines direct connected to generators, price per barrel for oil being placed at a high figure—in the case of the Diesel $1.50 per barrel, the cost of the steam plant $1.20 per barrel. It is interesting to note the difference in favor of the Diesel and its comparison with the total interest and depreciation on the Diesel plant.

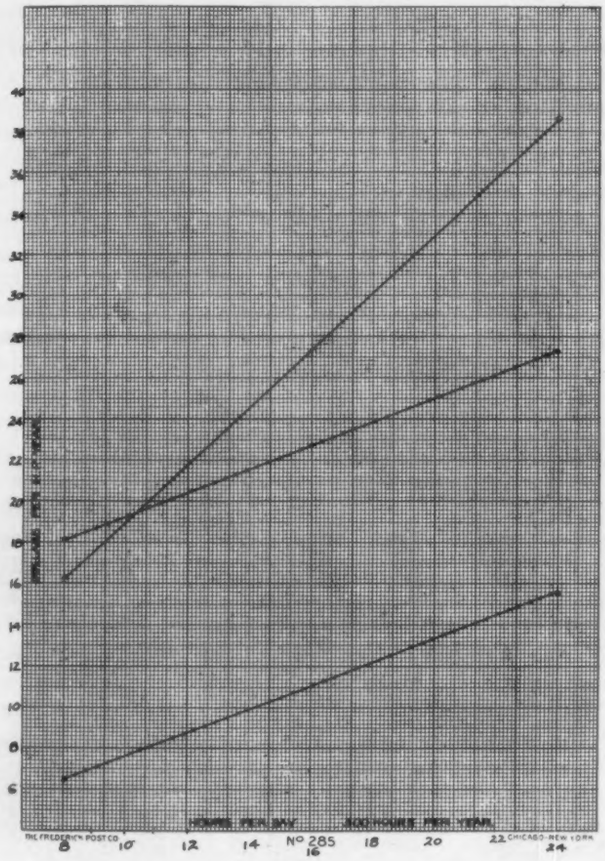


Fig. 27.

Another interesting comparison between the cost of power as produced by the Diesel engine compared with the cost of purchased electricity is illustrated in the following example: Assume a plant to consist of two 500 h.p. engines, generators, exciters and all necessary equipment, delivered and erected for $78,000, interest figured at 7 per cent per annum, a sinking fund of 7 per cent fixed charges, including taxes and insurance, to amount of 15 per cent per annum on the total investment. The operating cost is shown on the basis of 8 hours, 16 hours and 24 hours' operation, with oil as noted at $1 per barrel. The cost of power, including fuel oil, lubricating oil, maintenance, labor and fixed charges show a total cost per horsepower year varying from $18 to $27 as against the cost of purchased electricity at 1 cent per kw.-hr. of $16 to $38 per h.p. per year. The result of this comparison is plotted in Fig. 27 and shows that as the number of hours of operation increases the cost of purchased electricity increases at a more rapid rate than electricity produced by the Diesel engine and that if the plant is operated for over 10½ hr. the Diesel is the most economical type of prime mover. This emphasizes plainly the bearing of load factor to the cost of power compared with the purchase of electricity. If the proposed plant operates more than 10½ hr. it would be more economical to install the Diesel engine than to purchase electricity at the low rate of 1c per kw.-hr.

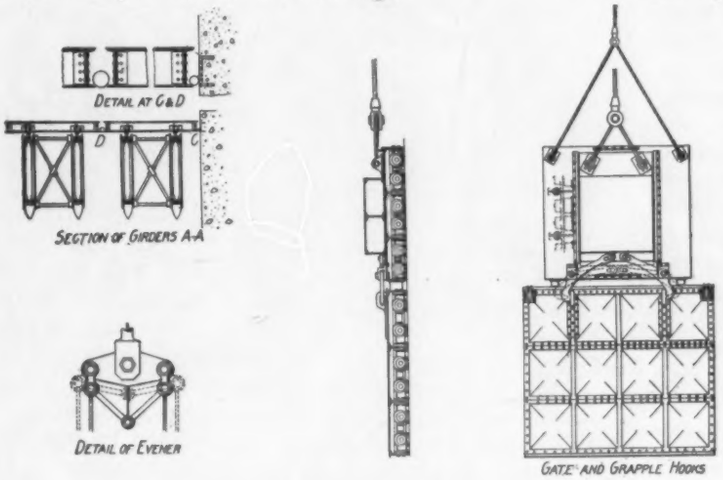
REPORT ON COLUMBIA RIVER POWER PROJECT.

BY L. F. HARZA.

Appendix G—Problem of Flood Control.

[Continued.]

The Camere gates. There are required for this scheme 11 openings each with bottom elevation of 70.0 and with a clear width of 80 ft. between piers together with a capacity in the form of roller dams equivalent to one additional opening. The 1894 flood rose to elevation 148.6 at which elevation the cross section thus provided is 6290 sq. ft. per opening or total area of 75,500 sq. ft., requiring a velocity of 18.7 ft, per second at entrance to the gateway and with a drop in level of 7 ft. (the available fall), a velocity of 20.4 ft. per second at discharge.



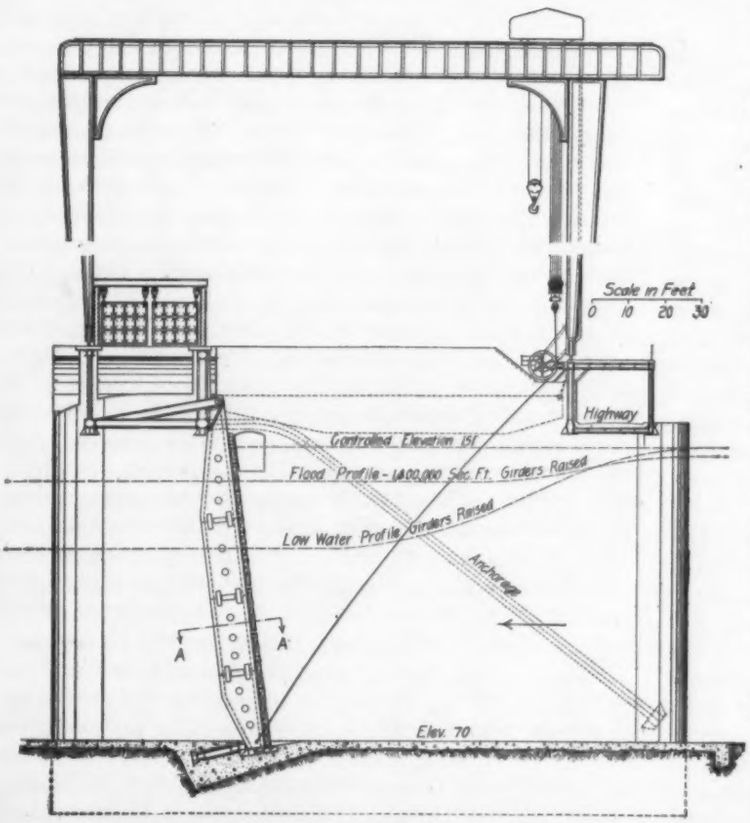


Fig. 37. Camere or Vertical Girder Type of Removable Dam.

A general drawing of this type of flood gate is shown in Fig. 37. The piers would be 20 ft. thick, 100 ft. apart between centers, and about 170 ft. long between pointed ends. They would be joined by a concrete arch used as a working platform at the downstream end of the piers, as also by two vertical steel trusses, one to carry the load of a traveling gantry crane and the other the pin connected or hinged ends of vertical steel girders, spaced about 7 ft. 8 in. apart and spanning from a seat in the bottom of the channel to a truss in a horizontal plane whose chords are built in with the lower chords of the two vertical trusses above mentioned and which is anchored into the upstream ends of the piers. At the upstream end of the pier would be a through highway bridge with an upper deck used for an operating platform and with one truss carrying the gantry crane. The girders (or wickets) would be free to turn about their upper pin bearings and would be built together in pairs with a heavy lateral system. Each pair of girders would be lifted out of the water by a gantry crane pulling vertically by means of two chains around sheaves on the lower end of the gantry leg and sustained horizontally while pulling by a pin connection to the upper lateral system of the bridge.

An auxiliary hook of the same gantry would raise and lower gates which roll on rails down the upstream side of the girders, thus completing the closure. The vertical girders, would be 10 ft. deep and about 92 ft. long, made (as shown in Fig. 37, Section A-A) of two outside web plates 18 in. apart, with interior flange and stiffeners. Access to the interior flanges and stiffeners. Access to the through frequent manholes in the center of the webs. They would be built and hinged in pairs with a lateral system designed to withstand a velocity of 33 ft. per second, assumed to approach the girders, when down and acting as a simple truss between upper and lower supports, at an angle of 20 degrees with the direction of the piers; but assumed to approach at an angle of only 10 degrees during the process of raising when this lateral load would need to be taken as a cantilever supported only at the upper pin connections. The difference in assumed angles of approach is based upon the assumption that, when down with part of the gates in place, an adjacent girder with gates removed would be subjected to a lateral load due to convergence of the lines of flow toward it. The girders would not be lifted until all gates were removed after which lines of flow would be nearly if not quite parallel to the planes of the girders.

The girders would seat on the bottom in cast steel depressed pedestals with large radius cylindrical bearing surfaces and attached to a steel grillage or a steel truss imbedded in concrete. At their upper end they would hinge in an eccentric pin which could be rotated sufficiently by a worm gear to lower the

girders onto a seat at the bottom, thus relieving the truss of their continuous weight although designed sufficiently strong to stand it. This rotation would also, if desirable, seat the girder at the top against a cylindrical cast steel seat on the chord of the horizontal truss, thus relieving the pin. Wedges as in a draw bridge could also be used to accomplish this latter purpose.

The gates would be of steel I-beams with buckled skin plate. The wheels would be of cast steel with finished hubs and rims and bronze sleeved shafts running in cast steel journals bushed with another composition of bronze, or roller bearings might be used as an alternative.

A scheme has been devised by which grease could be forced through the bearings by a small grease compressor actuated by the rotation of the wheel itself and so designed that it would cause the grease to flow and escape into the water regardless of the direction of rotation, thus not only lubricating the bearing but also preventing dirty water from entering. The wheels would be placed along the back of the gates, to run on crane rails along the upstream flange of the two companion girders. It will be noted in Section A-A, that the gates span the companion girders and one-half of the intervening opening, so that the wheels are protected in their position behind the gates. Each gate would clear the adjacent one by about 4 in., which opening would be sealed afterward by forcing down a 6 in. flush-joint pipe bearing upon the out-turned flanges of the side channels of the gates (except next to the pier where a smaller pipe would be used). A machine, not shown in the sketch, has been devised for forcing down and raising these pipes.

The gates would be raised and lowered by the auxiliary hoist of the gantry crane, using a grappling device shown in Fig. 37. This device consists of a steel structure similar to the gates (except narrower and filled with concrete for weight) and travelling on the girder rails on wheels of the same description. On the water side of this structure would be a sliding element filled with concrete or otherwise weighted and limited in its movement to a few inches. Extended arms of two grapple hooks would attach loosely to the lower edge of this sliding weight by means of slotted holes. With the weight at the upper limit of its movement the hooks would engage eyes at the upper edge of the gate and would disengage again upon lowering. The grappling apparatus would be lowered by means of the outer crotched line attached to the main structure, after which the tension would be reversed to the other cable and the gate would be engaged and raised. The gates would be stored by hanging from individual trolleys travelling on the lower flanges of I-beam supports along the concrete arch.

While the dam is closed the cables or chains which lift the girders would lie along the lateral bracing of the companion girders and behind the rolling gates. When it is desired to open a gateway the gates would all be raised by the auxiliary hoist and stored. The main hook from which is hung an equalizer (see Fig. 37) for pulling evenly the two chains, would then travel from the upstream end of the crane to the operating platform at the other end, carrying with it an auxiliary line from a motor-operated drum to the right of the main sheave, (not shown). The evener would then pick up the ends of the two pulling chains or cables and return to the upstream end, with the aid of the auxiliary line to prevent swinging to the left with the current, where with its further aid the chains would be brought around the sheaves ready to pull. There are two sheaves overhung from their bearings with their grooves spaced the same as the evener supports, which would make it very difficult by hand work to spread the chains sufficiently to get them around the sheaves. For this purpose the evener shown in Fig. 37 has been provided, in which the chains are spread by a toggle joint operated by a second line pulled by a small drum on the main trolley above.

The girders would then be raised from the water to a horizontal position shown dotted, where they would be hung at their lower ends by means of an eye bar, to the adjacent truss. The pulling chains would then be laid out for storage along the lateral system of the horizontally suspended girders by travelling the trolley to the left.

There are of course many details of construction and of the maneuvering program not described here. The loads to be lifted are large. The pull required to lift one pair of girders against the flowing water would be about 175 tons, the girders themselves weighing about 80 tons each. The auxiliary hoist would be of about 50 ton capacity for maneuvering the gates. The maneuvering program is somewhat elaborate and both the number and weight of parts to be handled are large. Mechanical means have however been worked out for each operation, only part of which are described herein.

Precedent. There is some precedent for the construction of a dam of this type. Several small ones have been built, as for example, for an emergency dam above the locks at Salt Ste Marie and some in Europe. The most important application, however, has been for the emergency dams in front of the locks on the Panama Canal. In this case the girders are hung from a draw span which must be swung across the channel in case of a wreck of the lock gates. The depth of water is 50 ft., length of girder 59 ft., width of opening 110 ft., velocity of water 24.1 ft. per second. Our conditions are as follows: Depth of water 80 ft., length of girders 92 ft., and velocity of water 33 ft. per second. Although our conditions are much more severe than on the Panama, yet it is believed they do not introduce problems of a fundamentally different nature. They would necessitate heavier girders, also the lifting of heavier loads for their removal and the use of a heavier lateral system to provide against possible lateral load when the girders are being lifted and act as cantilevers supported from the truss above.

Structures and lifting loads such as required, although never before used in a similar manner for hydraulic structures, are not unprecedented elsewhere. Stresses from hydraulic pressure can probably be computed with at least as high a degree of accuracy as those from railway loads and the lack of similar precedent for hydraulic structures need not be feared for this reason. The several supporting trusses do not involve serious problems.

The necessary rapidity of maneuvering the removable dam of whatever type, is indicated by the rates of rise of the river, of which the following are the largest on record:

February	4- 5, 1881	96,000	second	ft.	per	day
January	11-12, 1881	80,000	"	"	"	"
March	3- 4, 1910	77,000	"	"	"	"
May	27-28, 1894	74,000	"	"	"	"
June	3- 4, 1903	74,000	"	"	"	"
March	17-18, 1908	69,000	"	"	"	"
March	16-17, 1908	66,000	"	"	"	"
June	3- 4, 1909	65,000	"	"	"	"
March	16-17, 1906	60,000	"	"	"	"

The capacity of one pier opening ranges from 175,000 second feet at low flow to 120,000 second feet at extreme flood and careful estimates indicate that one day would be much more than sufficient for the opening of one section of the dam.

Roller dams. It is not proposed that close control of the head be had by means of these Camere gateways. For close regulation there are provided 7 steel roller dams of the type patented and built by the "Maschinenfabrik Augsburg Nurnberg A. G." at Gustavsburg, Germany. They would close openings having a clear width of 50 ft. between piers and depth of 30 ft., which is only slightly larger than structures already built and operated by this company. These gates would be in lieu of one opening of Camere dam and would have a capacity when all open of the same as the capacity of one Camere opening at greatest discharge. It is proposed that they be maneuvered to maintain a constant headwater until, in opening, the capacity of one Camera gateway is reached and the river rising, at which juncture they will be closed while one unit of the latter is opened. Each unit of the Camere type would thus be either entirely open or entirely closed. Two of these roller dams would be on the Oregon side and would be used as sluiceways for ice and drift which would be diverted into them by a boom. The remainder would be on the Washington side nearly parallel to the channel, as shown in Fig. 7, (p. 394, Nov. 20, 1915, issue).

Booms and Ice Menace. The roller dams would jointly have a capacity of about 175,000 second feet which, together with the minimum use of water by the power station, would provide for 225,000 second feet. A discharge greater than this has been recorded but three times during the season when ice is possible, namely:

February	6, 1881	361,000	second feet
February	18, 1898	260,000	" "
January	16, 1900	251,000	" "

The presence of ice was recorded in Appendix "B" only on the last occasion. The roller dams would therefore make it unnecessary, except on very rare occasions, to operate the Camere dam during ice season, for which the latter is not well adapted.

It should be said the safe operation of this type of dam when large driftwood or ice is running, is dependent almost entirely upon the successful diversion of same by a boom.

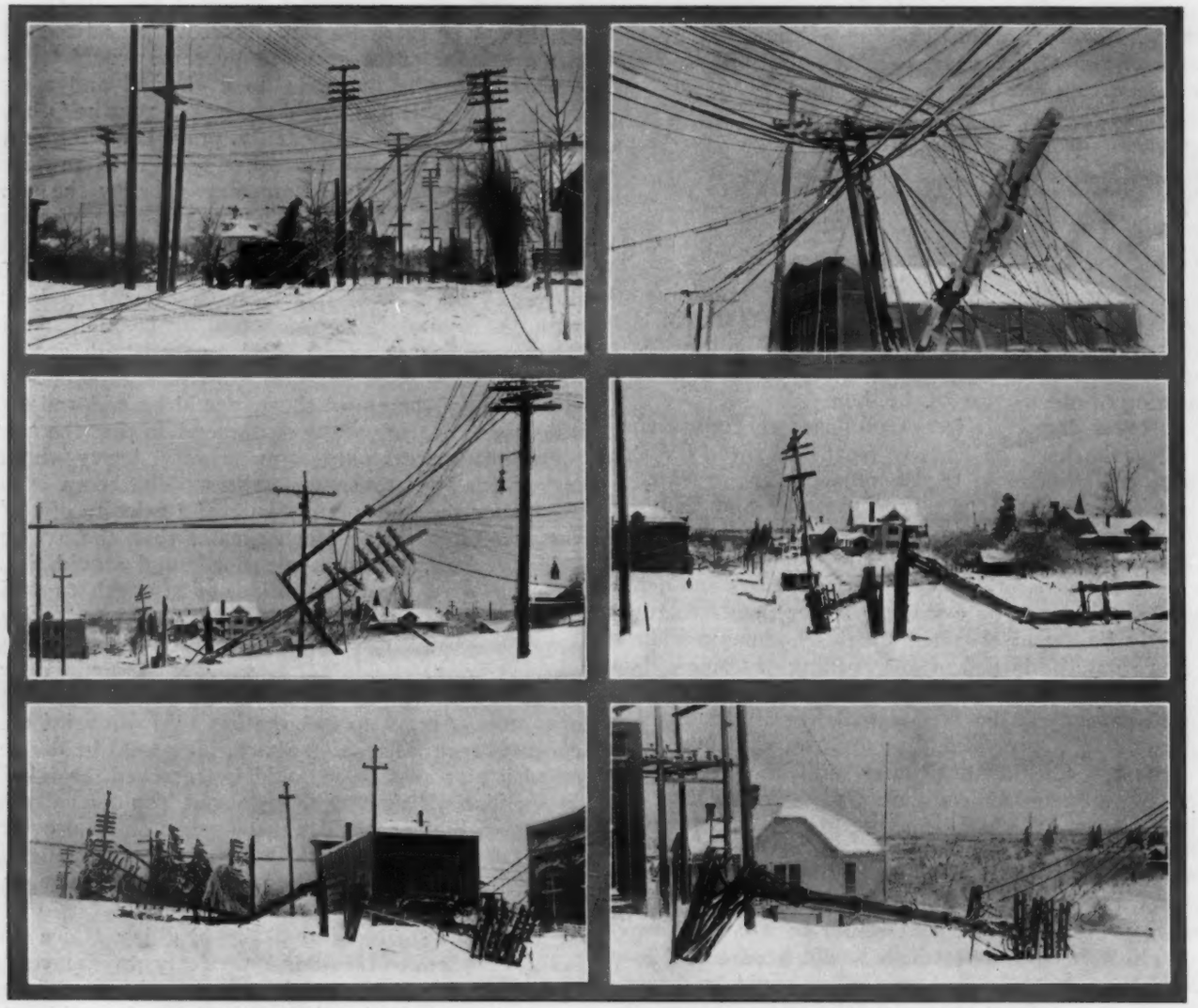
To accomplish this a boom has been provided as shown in Fig. 7, diverting to the roller dam on the Oregon side. The more natural point of discharge would be adjacent to the canal, where the approaching water might aid, but this point is far from the natural river channel and the flood channel into which discharge would take place is here far above tailwater level, for which reason it is feared that the debris would not be carried away. Moreover, if adjacent to the canal the space occupied by same would be deducted from the available flood channel and a secton of removable dam could not be built on the Oregon side to compensate without the provision of an extra operating crane. A boom has also been provided across the power canal immediately below the piers of the removable dam and another one at the forebay of the generating station.

The boom would be built up of solid timber 10 ft. deep and 30 ft. wide laid in courses breaking joints with the underlying course and driftbolted to it. Alternate courses would be channelled with grooves in a diagonal direction into which long bolts sufficient to take the entire shear, would be laid and provided with bearing plates at the end so that the completed structure would form a very heavy timber truss with steel tension members. The boom is designed for the dynamic pressure of a velocity of 10 ft. per second, which is much greater than the average velocity during an extreme flood, and would, it is believed, give the boom sufficient strength to withstand the pressure probable from drift ice, which comes only at a low discharge and consequently sluggish velocity. The boom would rest against two abutments and three river piers built as rock-filled open timber cribs up to elevation 145 with reinforced concrete rock filled cribs above. It would be divided at each pier so that it could be removed, or rebuilt in sections. This boom, if desired, could readily be used as a highway bridge. It could also be provided with rails on which would operate some special travelling rake for assisting the movement of drift toward the sluiceway.

It is not believed that the handling of ice will involve serious difficulties. Contrary to the conditions on eastern rivers, drift ice never runs except at a low flow of the river (see Appendix "E"), the highest recorded stage being that of January 16, 1900, at which time an average velocity of only about one foot per second would have existed just above the dam, with present stream bed, or about 1.30 ft. per second assuming the channel to be filled with sediment up to the sill of the removable dam. The usual stage during a run of ice is much less, and as the river would have a very low velocity for about 8 miles above, or to Celilo, and indeed very little fall for 25 miles above, it is believed that, due to the short duration of ice runs, what could not be passed by the sluiceways and would need to accumulate, would thaw out before endangering the structures.

Entire dependence, however, is not placed upon this belief. In case much ice had accumulated and was continuing to accumulate much faster than it could be passed and this condition threatened to continue to the point of danger to boom, piers or other works, several units of the dam could be opened behind the protection of the boom and one or more sections of the latter could then be loosened at the piers and allowed to swing back. The ice would then escape and flow only to the open units of the dam where no danger could result, it being remembered that injury to the dam from ice or drift would occur only during the maneuvering interval.

(To be continued.)



Typical Effects of Silver Thaw Along Lines of Portland Railway, Light & Power Co.

THE SILVER THAW AT PORTLAND.

The combination of sleet, high winds and freezing temperatures experienced at Portland, Ore., on February 2d and 3d, wrought considerable havoc with electric distribution, railway, telephone and telegraph wires, as is graphically shown in the accompanying pictures. Street car and railway traffic was demoralized. Portland was entirely shut off from rail communication east.

Even the taxicabs were forced to suspend service.

Electric lighting service in the large East Side district and in many other quarters was destroyed by broken poles and wires.

Street cars operated only at irregular intervals. The company gave no assurance of regular service on any line.

Thousands of telephone wires in scattered sections of the city went down.

Morrison street bridge open; couldn't be closed; street car traffic over it was impossible. Broadway bridge couldn't be lifted.

Schools were closed until Monday, February 7th.

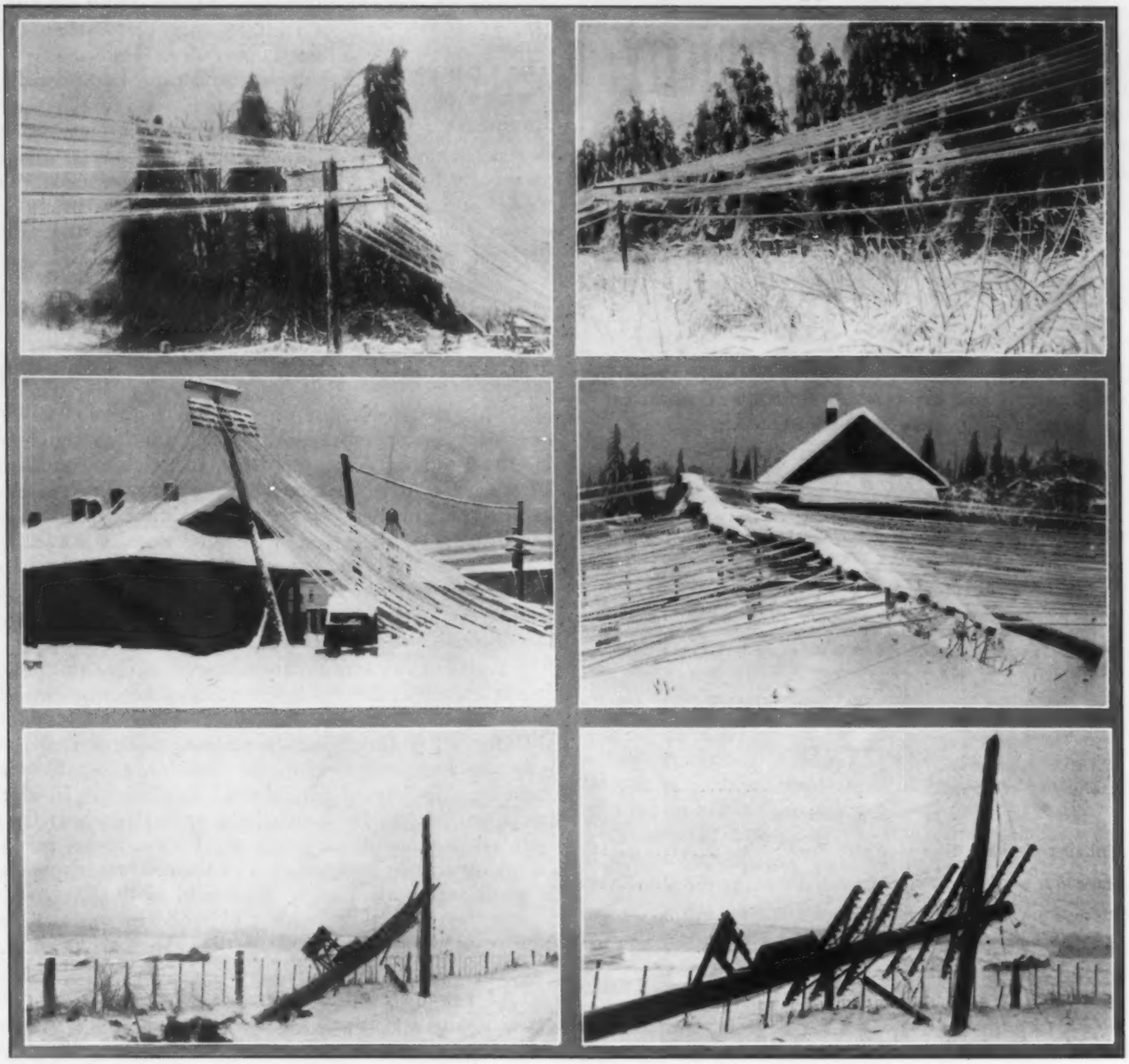
Damage from broken wires, poles and other property was very heavy.

Many people could not reach their homes and had to remain on the West side of the river. The department stores allowed many of their employes to remain in the stores over night.

Five hundred dollars a day was spent by the Pacific Telephone & Telegraph Company in housing and feeding those employes who were unable to get to and from their homes during the storm and in buying toothbrushes and combs for those who are kept down town. Half that amount additional was spent daily in taxicab fees, other employees being sent to their homes in automobiles.

The number of calls over the wires of the telephone company has been doubled during the past few days, the storm making it necessary for stranded business men to telephone their wives of their inability to get home. The plea was made that gossip and lengthy conversations be temporarily eliminated in order that the company may be able to handle all the emergency calls that it had been called on to transmit because of the extreme weather conditions.

By the 5th, car service and vehicular traffic were opened upon the principal car lines of the residence sections. This was acomplished with the assistance of about 3000 men, 1000 of them in 17 crews under the direction of Commissioner Baker and Park Superintendent Convill, and 2000 under Fred Cooper, super-



Effects of Silver Thaw on Telegraph and Telephone Lines.

intendent of the Portland Railway, Light & Power Company. The cost of the snow storm to the city alone, paid out for labor, was $30,000.

All of the engineering force of the Portland Railway, Light & Power Company turned out and gave their assistance as foremen or any other job that would assist in restoring service.

The loss as "estimated" by the various companies affected is as follows:

Western Union Telegraph Company—$2500 to $3500. Worst damage north of Portland.

Home Telephone & Telegraph Company—$25,000. Worst damage in Lents and Mt. Scott Districts. No cable work came down except where same was caused by power "burn outs" on same. One pole lead of 67 poles, with 2 and 3 crossarms, all down except 3 poles.

Northwestern Long Distance Telephone Company—$5000 to $10,000; 6 pair lead between Portland and Vancouver, Wash., all down.

Postal Telegraph Company—$10,000. In 21 miles north of Portland between Portland and Goble, there is 21 miles down, with two or three poles standing.

Pacific Telephone & Telegraph Company—$10,000.

S. P., and S. & United Railways—$10,000.

Portland Railway, Light & Power Company—$140,000. Includes loss of substation at Mt. Tabor.

Northwestern Electric Company—$5000. Break in cable across Columbia River.

Outside construction in Portland was not damaged much as it was extremely heavy in most cases, having been put up for "joint pole" occupancy.

Consequently it is safe to say that the loss occasioned by the storm in a radius of 50 miles of Portland, to the public utilities is half a million dollars.

On the 12th of the month with every available man working overtime, progress was slowly being made in repairing damage done by the recent storms to wire systems of telephone, telegraph, electric lighting and railway companies in and adjacent to Portland. Because their services were needed locally, it was impossible to recruit the local crews of linemen to any large extent from other cities and the work of repair will take longer than had been expected.

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NOTICE TO ADVERTISERS.

Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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The Change in Fashion of Engineers

Some years ago engineers were agitating the question of whether the consulting engineer was an economic superfluity. Like many another question, time has furnished the answer. The original type of consulting engineer is fast becoming an economic superfluity but the new type is just as rapidly becoming an economic necessity. The 1916 model of an engineer differs as much from the model of ten years ago as do two automobiles of the same periods.

The consultant's former function was largely that of an individual designer of special apparatus for each new installation. His present duty is largely confined to the selection from a number of available designs of the one best suited to the installation.

This change is due to the standardization in the design of machinery, which has eliminated the need for much of the designing work in new construction. There was a time when most of the apparatus installed in power plants was made in accordance with special specifications. The early California hydroelectric transmission systems, for example, had to be designed on the job and not in the factory. Factory designed equipment had not yet been conceived to meet the requirements of advanced practice.

Today many large manufacturers refuse to bid on special specifications from engineers because experience has shown that standardized apparatus is available for all ordinary needs. Steam boilers are now built in accordance with the standards set by the American Society of Mechanical Engineers. In electrical equipment, the best of the special designs have been adopted as staple practice. Furthermore, manufacturing service now anticipates the consumer's needs. It leads rather than lags. The field of the designer's activity is becoming more and more limited to the factory as the manufacturer realizes that profit comes only from making a staple of the specialty.

This trend is in accord with the natural order of growth which governs all things. The first stage in evolution is aggregation, the next is standardization and the last is segregation or specialization. Then the process is repeated. Power machinery has about reached the second stage in the present cycle.

So, while the threatened encroachment of the catalogue salesman on the functions of consulting engineers has now become an actuality in many lines, the dire results which were feared have failed to materialize. This has been largely due to the improvement in salesmen. The present day salesman is frequently a better engineer in his specialty than is the consultant, the hide-bound restrictions of some engineering clubs to the contrary notwithstanding.

Coincident with the salesman's improvement has been an enlargement in the scope of the consultant. His judgment, instead of being narrowed to the determination of new means to accomplish a desired purpose, has been broadened to a discrimination of what existing means best fits that purpose. The new consultant should be familiar with all makes of apparatus so that he can draw from his own experience and the experience of others in deciding how his object can best be accomplished.

Engineering Preparedness

The first engineers were military engineers. Then as the barbarities of war became secondary in the minds of men to the needs of civilization, the civil engineer came into existence. Civilization brought specialization among mechanical, electrical, mining, chemical and a host of other kinds of engineering, taking them far afield into new lines of investigation.

Now that war, or at least defense against possible war, is again engaging the attention of men, it is found that the lessons learned in civil life, many of which have been necessarily neglected by military engineers, can be applied to the national defense. Though here and there a jealousy of encroaching prerogatives seems to exist, as perhaps evidenced by the resignation of Secretary Garrison, as a whole, military men welcome the co-operation of civilians.

Army men realize that engineers in civil life can be of the utmost assistance in defense if they are properly instructed as regards the requisite organization and possible duties. Lectures are consequently to be given on these subjects by qualified army engineers all over the country.

The present European struggle has demonstrated the need for men who understand the construction of earthwork defenses, trenches and the like, the rapid building methods of communication, the laying of concrete foundations for large guns, the providing of proper sanitation, housing and water supply for camps and supervision of munition manufacture. These are the regular field undertakings of construction engineers and their experience should prove invaluable in military service.

Modern warfare is primarily an engineering problem. The great need seems to be for a reserve corps of engineers should any important contingency arise. This is solely because of the limited number of army engineers available, less than one per cent of the number represented by membership in the several "civil" enginering societies.

Already the national engineering societies are cooperating in a movement to provide an adequate reserve of engineers who would be willing to receive the necessary instruction and to act in emergency. There is no thought of pay for such service, merely a loyal response to the nation's needs. In this way it is possible to repay the debt which many engineers owe the government for their technical education. It has already been made possible for them, under an act of Congress dated January 21, 1903, to take an examination for commission in any volunteer force, other than the organized military called for by Congress in event of war. With such opportunity for service the engineer would be remiss in overlooking it. Engineers have always complained that they are not accorded public recognition commensurate with their ability. Now is the time when these engineering qualifications are at a premium in the public service and here is the chance for the engineer to demonstrate his patriotism and to vindicate his contention.

Guiding Human Nature

Why is it that after the economic error of such disturbing elements as the jitney bus, the curbstone electrical contractor and municipal ownership of technical utilities has been conclusively proved again and again that people persist in trying to accomplish the impossible? Why does the mathematical certainty of failure not deter others from rushing in and making fools of themselves? The answer is human nature. It apparently heeds neither the truths of economics nor the laws of mathematics.

For instance, the science of economics has definitely demonstrated that labor will be helped by the introduction of efficiency methods, scientific management and bonus payments. It is human nature for the labor union to oppose such innovations.

Again, mathematical proof of the fact that bodies which had sunk to a depth of two miles would not come to the surface was announced by a Harvard professor after the Titanic disaster, when young Vincent Astor offered one hundred thousand dollars for the recovery of the body of John Jacob Astor. Yet the searching parties found not only the body of Astor, but also of many others who had merely put on life preservers. Thus did human nature confound mathematics.

About the time that one man finds that it is hopeless to run a jitney at a profit there is another ready to take his place. As fast as one curbstone contractor fails he is replaced by another. There is always a new crop of municipal ownership advocates ready to fill the ranks left vacant by the discredited. The supply of the foolish is said to be replenished at the rate of one a minute and to be everready to precipitate themselves into situations where the super-wise hesitate to venture.

This particular phase of human nature is due to ignorance. It is the inertia that limits human progress. It cannot be suddenly reversed but can be gradually guided. While, as already stated, it apparently acts contrary to the principles of economics and mathematics, in the long run it will be seen to conform to them.

Concretely, this means that education is the only corrective for such economic errors as has been here pointed out. Far-sighted men of affairs realize that human nature can be guided by teaching it and so it behooves constructive organizations like the National Electrical Contractors' Association, the American Electric Railway Association and the National Electric Light Association to conduct a campaign of education in order to remove the evils which threaten their path.

To be effective, it would sometimes appear that such educative campaigns should be based upon an appeal to passion rather than to reason. This is the method adopted by the demagogue in appealing to the motive of hatred. Cold facts seem to have little chance in the heat of the passions thus generated. To fight fire with fire it seems desirable to employ the baser motive of self-interest. Teach the individual that in these practices he is hurting himself more than the other fellow and he will desist.

PERSONALS

W. S. Berry of the Western Electric Company, and wife, leave for Honolulu on February 23d to be absent for a month.

C. R. Downs, president of the Amador Light & Power Company of Amador, California, was a recent visitor at San Francisco.

John Hood, engineer with the General Electric Company, at San Francisco, has returned after a brief business trip throughout the Sacramento Valley.

Robert E. Richardson, an official of the Electric Bond & Share Co., of New York, is at Salt Lake City investigating the rates of the Utah Power & Light Co.

F. H. Leggett, Pacific Coast manager of the Western Electric Company, has returned from a trip throughout the northwest. He reports business prospects very bright.

B. J. Klein, Pacific district manager of the Bristol Company, has returned to San Francisco after a successful business trip to Los Angeles and the San Joaquin Valley.

J. L. Randolph, president and general manager of the Turlock Home Telephone & Telegraph Company of Turlock, California, was a business visitor at San Francisco last week.

Frank Fowden, formerly connected with the Brooks Follis Electrical Corporation of San Francisco, has recently joined the sales force of The Appliance Company at San Francisco.

C. B. Hall, secretary and treasurer of the Illinois Electric Company of Los Angeles, is attending the quarterly meeting of the National Electrical Supply Jobbers' Association at Detroit, Mich.

Miles Steele, salesman with the Benjamin Electric Manufacturing Company at San Francisco, has just returned after an extended business trip throughout Arizona and southern California.

H. B. Kinney, formerly of the Calistoga Light & Power Company of Calistoga, has recently severed his connection with that company and is now connected with The Appliance Company of San Francisco.

Jos. Minnie, electrical engineer with the Pacific Gas & Electric Company, has returned to San Francisco after an extended tour of inspection of the power plants of the company throughout Northern California.

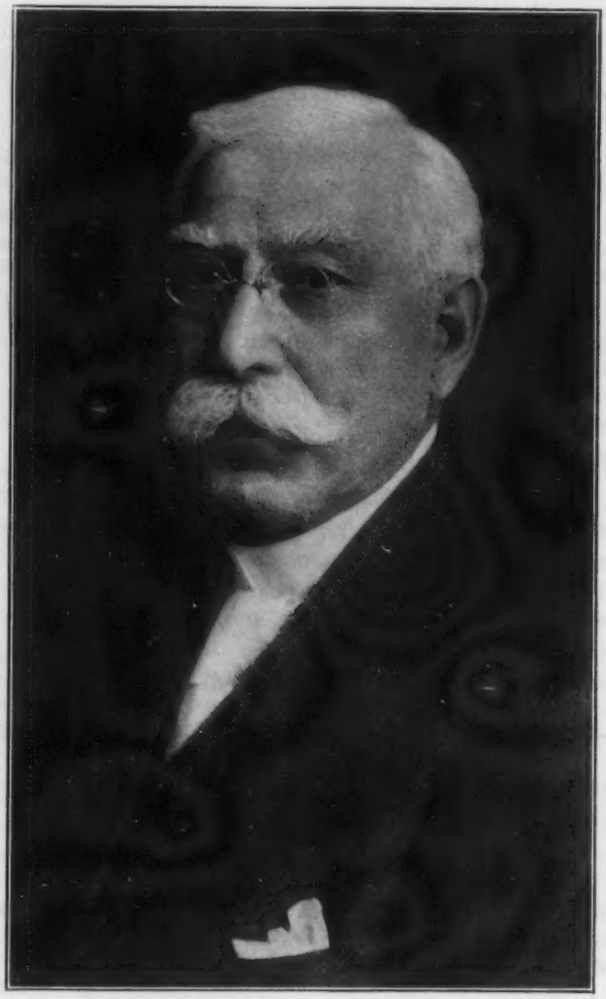
Wynn Meredith, member of the firm of Sanderson & Porter of San Francisco, is expected to return about the middle of next week from his recent trip to New York, where he attended the annual meeting of his company.

Albert Meinema, city sales manager Electric Appliance Company; **J. C. Kelsey,** vice-president and financial editor Telephony, and **R. H. Coyne,** Pacific Coast sales manager Kellogg Switchboard & Supply Company, conversed over the long distance telephone lines from San Francisco, Redlands and Los Angeles, Cal., respectively, with delegates in attendance at the Wisconsin Independent Telephone Association at Madison, Wisconsin, last week.

Chas. R. Betts, Palo Alto, California; **F. E. Draper,** safety inspector and safety engineer, Los Angeles, Cal.; **L. B. Hedge,** chief electrician Ely Light & Power Company, East Ely, Nevada; **E. L. Hughes,** electrician Northern California Power Company Cons., Red Bluff, Cal; **M. L. Jones,** light and power solicitor City Light, Seattle, Wash.; **H. F. Lickey,** instructor of physics and mathematics, Hailey High School, Hailey, Idaho; **R. Gordon McCurdy,** engineer Joint Committee on Inductive Interference, Railroad Commission of California, San Francisco; **S. W. Park,** electrician, Britannia Beach, B. C., Canada; **F. B. Post,** draughtsman electrical engineering department, Puget Sound Traction, Light & Power Company, Seattle, Wash., and **O. E. Smith,** switchboard operator, station M, Portland Railway, Light & Power Company, Estacada, Ore., have been elected associate members of the American Institute of Electrical Engineers.

OBITUARY.

Delos Allen Chappell, president of the Nevada-California Electric Company, died at Denver, Colorado, last week from pneumonia. His death marks the passing of a man truly great in character and in achievement, one to whose foresight, energy and remarkable ability is due in a large measure the development of the latest resources of the West. Born near Williamson, Wayne Co., New York, April 29, 1846, he spent most of his early life on the farm. He was a student of the



Delos A. Chappell.

University of Michigan with the class of 1870 until an accident to his father made it necessary for him to take his father's place in the management of the farm.

In 1873 Mr. Chappell assisted in the construction of the water supply system of the city of East Saginaw, Michigan. The experience thus gained led him to engage in 1874 in the engineering and contracting business at Chicago where he continued in the business of constructing numerous water works until 1879, when he removed to Trinidad, Colorado, where he undertook the construction, as a private investment, of the water works system for the city of Trinidad, which was later purchased by the city. It was at this time that he became identified with the development of coal mines in Colorado, and his ability as an organizer and manager of large developments soon made him a power in the mining industries of the state.

After developing a number of large coal properties which were subsequently leased to the Colorado Coal & Iron Company, he purchased and operated the mines his interest in which he sold to the Victor American Fuel Company in 1906, when he withdrew from active participation in the business and spent a few years abroad with his family.

On his return home, he became interested in the development of electric water power on Bishop Creek, Inyo county, California, the first power plants being constructed for the purpose of serving the then growing mining camps of Goldfield and Tonopah. Subsequently, he became largely interested in the power developments of the Pacific Power and other companies in Mono county, California, all of the developments meantime being gradually merged and consolidated into a unified system serving a large and growing section of western Nevada and central and southern California.

Within the last year, largely through Mr. Chappell's instrumentality, the organization of The Nevada-California Electric Corporation (of which he was president) was consummated, this latter company acting as a holding corporation for numerous underlying companies, including The Nevada-California power Company, The Southern Sierras Power Company, Bishop Light & Power Company, Corona Gas & Electric Light Company and the Interstate Telegraph Company. Recently, the same interests with which Mr. Chappell was identified took over the Holton Power Company, Coachella Valley Ice & Electric Company and the Holton Interurban Railway Company, previously developed and operated by W. F. Holt, of Redlands. The deal by which the latter companies were taken over was finally consummated on January 15th, the day Mr. Chappell met with the accident resulting in his death.

On December 19, 1883, Mr. Chappell was united in marriage to Miss May Chase Hastings, who died at Santa Barbara in 1911. There survive a son, Delos A. Chappell, Jr., now a student at Stanford University; a daughter, Jean Chappell Cranmer and his sister-in-law, Mrs. Margaret Officer, who since Mrs. Chappell's death, has made her home with Mr. Chappell in California.

N. E. L. A. ELECTRIC RANGE COMMITTEE MEETING.

The future of the electric range business was discussed at a meeting of the electric range committee of the Commercial Section of the National Electric Light Association at Salt Lake City on February 7th and 8th. The greatest present factor in popularizing the electric range is the solution of the water heating problem. The committee agreed that the electric water heater can be used only as an auxiliary and that the solar heater is best adapted for most of the Western territory.

Plans are being prepared for a co-operative advertising campaign for electric ranges and other devices, the national advertising being of such a nature that each central station can tie in its local advertising with it.

The committee has a number of suggestions on the size, type and make-up of ranges which will be followed by the manufacturers. The final report of the committee will be presented at the Chicago convention of the National Electric Light Association in May.

The following members of the committee were in attendance: W. R. Putnam, sales manager Utah Power & Light Co.; S. M. Kennedy, general agent Southern California Edison Co.; M. C. Osborn, manager commercial department Washington Water Power Co.; S. V. Walton, manager commercial department Pacific Gas & Electric Co.; E. A. Wilcox, heating device specialist Great Western Power Co., and A. C. McMicken, sales manager Portland Railway, Light & Power Co.

Representatives of range manufacturing companies present included A. K. Baylor of the General Electric Co., Geo. Hughes, president of the Hughes Electric Heating Co.; E. H. Richardson, secretary Hot Point Electric Heating Co., and Mr. Kahn, of the Estate Stove Co.

S. R. Inch, operating manager of the Utah Power & Light Co.; Robt. E. Richardson, of the Electric Bond & Share Co.; H. D. Randall, Salt Lake manager for the General Electric Co.; C. D. Lamoree, sales engineer with Westinghouse Electric & Mfg. Co., and several representatives of the Utah Power & Light Co., were also in attendance.

MEETING NOTICES.

San Francisco Electrical Development and Jovian League.

Notwithstanding the absence of both the president and the vice-president the luncheon February 9th, under the able leadership of R. M. Alvord, chairman of the executive committee, maintained the high standard of excellence and interest which has been set. This was in no small measure due to S. P. Russell, manager of the H. W. Johns-Manville Company's electrical department, who as chairman of the day, had provided fine music and a good speaker in the person of L. R. Hoff, general sales manager for the company. Mr. Hoff took as his subject "Business Building for the Future," showing that the holding of our position in world trade demanded sincerity, integrity and a high ethical plane of business dealing.

Oregon Electrical Contractors' and Dealers' Association.

On February 9th the Oregon Electrical Contractors & Dealers' Association was practically reorganized, a new set of by-laws and code of ethics being adopted. New officers and a board of trustees were also elected. The interests represented are following out a line of action by which they desire to conserve the electrical business for the strictly electrical concerns. This, to offset the fact that in recent years many firms have added electrical features to a business which is in the main devoted to some other line. Under the new organization, "central station" men, jobbers and others not actually retailing or contracting in the electrical line, but who manufacture or deal in power or electrical equipment are given an associate membership in the state organzation. The new set of by-laws, of which the code of ethics forms a part, will tend to carry out the desires of the dealers and contractors who devote their entire time to the electrical business, that the business should remain in the hands of those actually engaged therein, and not be "shot to pieces" so to speak, in the hands of those who merely look at it as a "side issue." The new officers elected by the organization include W. O. Fouch, of the Western Electric Works, president; S. C. Jaggar of the Morrison Electric Company, and J. Tomlinson, of the Pierce-Tomlinson Electric Company., vice-presidents, and these last two with F. C. Green of E. L. Knight & Company, and Guy C. Littler of the West Coast Engineering Works, as a board of trustees.

Portland Sections A. I. E. E. and N. E. L. A.

The regular monthly meeting was held February 8th in the auditorium of the Electric Building, Portland, Oregon. Mr. J. E. Davidson acted as chairman. The first speaker of the evening was Edw. Cockingham, vice-president Ladd & Tilton Bank, on the subject of "Finance." He said in part, "All finance is built upon 'credit.' Credit is a promise to pay on demand at a future time. Confidence is the structure on which 'credit' is built. Confidence, to endure, must be built upon a sound foundation. A government $10 federal reserve note is a good illustration of national credit. The banking power of the United States exceeds that of England, France and Germany combined. This represents $187,000,000,000. Nine-tenths of the world's business is done on credit. The government's credit is strong because it has the power of 'eminent domain' or taxing power. There are twelve essentials which a mnufacturing concern must have before it can hope for success. (1) A useful article to manufacture; (2) It must be organized into a good company; (3) Must have necessary capital; (4) Must have a proper business policy; (5) Must have a competent business manager; (6) Must have a proper location; (7) Must have a well designed plant; (8) Must have a good organization; (9) Must have a loyal organization; (10) Must have perfection in the design of its products; (11) Must have a perfect system of manufacturing; (12) Must have a complete and comprehensive system of accounting.

It has been said many times that the most necessary prerequisites for the success of a business are the three 'C's,'

Capital, Capacity, Character. Reviewing the present financial conditions he quoted from a Scotch author the following: "War brings Poverty, Poverty brings Peace, Peace brings Prosperity, Prosperity brings Pride, Pride brings War." Before the present war England was the credit nation of the world and the United States a debtor nation. A pound sterling was the standard of exchange. There were 5 to 6 billion United States securities held in Europe. In 1870 Germany did 7 per cent of the world's commerce; in 1910 she did 18 per cent; and it must be remembered that the world's commerce increased in volume in a tremendous manner during these years. During this time she developed a military machine and a great industrial machine as well; also a colonial system was developed, also a navy and merchant marine. This rivalry between England and Germany for trade and economic supremacy caused the war and not political differences. During the first year of the war $1,8000,000,000 trade balance in favor of the United States was gained and about $1,500,000,000 of the United States securities were absorbed. In the future I see 'Opportunity' and 'Peril.' Germany's industrial power is only sleeping. Her markets of the past will be cut off, England, France and Russia—so she will turn to North and South America."

Mr. Cockingham called attention to the fact that this year was the one hundredth anniversary of the first public savings bank in the United States and said he wanted to impress upon all those present the necessity of "thrift."

The second speaker, Mr. Ben C. Dey, assistant counsel Southern Pacific Railway Company, did not speak upon the subject assigned him, "Elementary Principles of Business Law," as he said he could not do justice to the subject in the limited time he could speak. Instead he made a few remarks on the subject of "Contracts." Also stated that he was in favor of a law requiring a "Bill of Necessity" from public utilities before new corporations could go into business in the state of Oregon. The public were absolutely protected, as the public service commission had the power to regulate the "rates" and the "service." As the present regulation, both national and state, is very burdensome and inefficient, a new bill has been formulated and introduced into congress by Mr. Cook, attorney for the Postal Telegraph Company, to regulate the railroads of the United States. Government ownership of railroads is not desirable under our form of government, as they would become a dominating factor both politically and financially.

The idea of the Cook bill is to take the control of the railroads away from the capitalists and give it to the people. At the present time there are 117 directors, having control of the 160,000 miles of railroads in the Mississippi Valley, which comprises 24 states. Twenty-three directors live in the Mississippi Valley and fifty-eight live in New York City. The Vanderbilts control their properties and only own 8 per cent of the stock. Hill controls the Great Northern with 7 per cent of the stock. One-half of the stocks of the railroads are held by other railroads. The bill provides for five federal railroad companies. Each company to have nine directors, six elected from the district in which the company operates. A federal board to be composed of six members, one from each federal company and one from the Cabinet of the United States, to be appointed by the President. Money to operate under being raised by guaranteed government bonds; interest to be 3½ per cent; stock to be issued in $10 denominations. It is estimated that the government would make $24,000,000 a year profit after paying the 3½ per cent. The scheme would eliminate waste and bring us "Industrial Peace," is claimed by the author.

He mentioned the fact also that locomotive engineers were paid on an average of $215 per month. Motor men on interurban electric trains, $175 per month, and conductors $146 per month.

After the meeting doughnuts and cider were served. The next meeting will be under the auspices of the A. I. E. E. and Prof. Wm. C. Morgan of Reed College will give a talk on "Industrial Chemistry."

Oregon Society of Engineers.

The fifth annual meeting and banquet of the Oregon Society of Engineers was held at the Portland Commercial Club, February 7th.

The report of Secretary Stanley consisted of a short talk on "Co-operation." The report of Treasurer Morse showed that the society had expended $919.04 during the year and had funds to the extent of $731.45 on hand.

The first issue of the Journal of the Oregon Society of Engineers was distributed at the banquet and it was explained by the secretary that it was the intention of the association to print all the papers available in the journal—including those presented before the society and any others deemed worthy which are contributed by the members. In addition to this the society will publish a monthly bulletin.

The returns of the election held during the past month were announced:

Philip H. Dater, Vice-Pres.	F. H. Naramore, Director.
Orrin E. Stanley, Secretary.	H. L. Vorse, Director.
Henry M. Morse, Treasurer.	Douglas Taylor, Director.

An amendment to the constitution was passed making provision for student members, dues to be $1 per annum.

The subject of permanent headquarters was brought up for discussion, and the subject was referred to the executive board with instructions to investigate the subject and see if the other technical societies would entertain a proposition to enter into an agreement to establish a permanent place for an "engineering headquarters." Also to see if same could be had in the Commercial Club Building. It was announced by the president that the Oregon Society of Engineers would be represented by delegates at the conference held in Eugene for the purpose of discussing "Irrigation and Rural Credits."

The second portion of the program consisted of a motion picture show, at which the Finley pictures of animal life were shown. Ladies and friends of the engineers were guests of the society for this portion of the annual meeting. Attendance at banquet, 55.

Los Angeles Jovian League.

The regular weekly luncheon was held February 9th at Christopher's, President Holland occupying the chair. H. N. Sessions, the astute and versatile compiler of programs, announced "A swell feed, a peacherino talk, a fine entertainment, and a chance to mix with the gang." Harry was right. A large number of visitors were present, and after the introductions and discussion of various business matters, at which time J. Harry Pieper announced the appointment of a Jovian Committee to assist in the Occidental College $1,000,000 campaign, the gavel was turned over to Jas. E. Tucker, vice-president and general manager of the Greenwood Advertising Company, whose popularity as a Jovian was demonstrated by the loud and prolonged applause which greated him. After a few remarks, he introduced the speaker of the day, Rev. Robert Freeman, pastor of the Pasadena Presbyterian Church of Pasadena, who spoke on "Individuality." His address was interspersed with Scottish dialect stories, and his rare wit and humor kept his audience in a continual uproar. He defined individuality as the discovery of, and the conformity to, the laws of one's own being; and said that it is the duty of each generation to discover and apply new laws hitherto unknown, the duty of each individual to discover laws for the elevation of his own personality, to discover his own capabilities, and to live in harmony with the higher laws. An excellent musical program was also provided.

Considerable interest is being manifested in the coming rejuvenation, to be held February 18th at the Elks' Hall, which is expected to surpass anything that has heretofore been attempted here. R. C. Starr is chairman of the arrangement committee, E. B. Clay will supervise the floor work, and A. L. Spring will captain the degree team.

NEWS NOTES

INCORPORATIONS.

TUCSON, ARIZ.—Articles of incorporation of the Rillito Water Company has been filed by Heber E. Farr, Frank J. Webb and Louis P. Cardon, all of Tucson. The authorized capital stock is $50,000.

TEMPE, ARIZ.—The Burns Electric Company has filed articles of incorporation with principal place of business in Phoenix. Capital stock, $1,000,000. Incorporators, Paul H. Schmidt, Herbert Harper and Michael A. Burns, all of Evansville, Ind.

SALEM, ORE.—The West Coast Gas Company, capital stock $5000, S. R. and Velma Hammer and P. A. Williams, incorporators, has filed articles of incorporation. The company proposes to establish steam, gas, light and hot water plants in Linn county and will have its headquarters at Albany.

LOS ANGELES, CAL.—The Omega Mutual Water Company, which has just incorporated, will furnish water for the 73,000 acre tract of the San Joaquin Valley Farm Lands Company near Fresno. The concern is incorporated for $500,000. It will operate pumping stations and pipe lines to be installed soon. Fifty artesian wells will be sunk.

FRESNO, CAL.—Certification of the articles of incorporation filed almost a year ago by the Fresno Interurban Railway Company, at Sacramento, was recorded in the court house here recently. According to the copy of record filed here, the company is capitalized at $250,000, with but three stockholders. George H. Bradner owns 98 shares and John B. Rogers and Paul T. Fratessa own one share each. It is stated that the par value of the shares is $100 each and that $10,000 has thus far been paid into the treasury. The Fresno Interurban Railway Company plans to build a standard gauge line to accommodate both passengers and freight between Fresno and Clovis, a distance of about 10 miles.

ILLUMINATION.

BURBANK, CAL.—Sealed bids will be received by the board of trustees up to February 23 for electrical equipment.

SANTA CLARA, CAL.—Electroliers are to be installed the entire length of Franklin street when sufficient funds are at hand.

MARTINEZ, CAL.—The supervisors have granted permission to the Contra Costa Gas Company to lay its mains to Port Costa, Crockett and Valona.

RIVERSIDE, CAL.—The city council has ordered the installation of a street lighting system along the west side of North Orange street, between Russell and Oakley avenue.

NEWPORT BEACH, CAL.—The recently voted bonds of $24,000 for a natural gas distributing system have been bought by the state, at a premium of $615. Work will begin at once.

PHOENIX, ARIZ.—The New State Electric Supply & Fixture Company has been awarded the contract for additions to the underground street lighting system on its bid of $18,300.

WINSLOW, ARIZ.—A franchise for a gas plant has been granted to B. A. Hayden of Los Angeles. Construction of the plant will begin within 60 days, and be in operation within six months.

SAN FRANCISCO, CAL.—The supervisors have approved an appropriation of $7,500 as the city's share for current furnished to the proposed Ryan scheme of illumination of Market street from the ferry to Seventh street.

PASADENA, CAL.—There was only $12.88 difference in two bids for electric materials and machinery received by the commission. The bidders were the General Electric Company, $8199, and the Westinghouse Company, $8211.88.

PHOENIX, ARIZ.—The city commission has directed the city engineer to make an investigation regarding the installation of a municipal electric and gas plant and report findings at the meeting on March 15th.

EUGENE, ORE.—The petitions for ornamental lights on Seventh avenue between Olive and High streets and Eighth avenue were reported favorably by the fire and water committee at a recent meeting of the city council.

HUNTINGTON BEACH, CAL.—At a meeting of the board of trade it was voted unanimously to accept the offer of the Southern Counties Gas Company to serve natural gas at 90 cents per 1000 cu. ft., with a 90 cent minimum charge.

TRANSMISSION.

KALISPELL, MONT.—The Montana Power Company has definitely decided upon the construction of a big hydro-electric plant on the Missouri river near Wolf Creek, according to a statement of an official of that company. The survey will be started in the spring. The site is 30 miles northwest of Helena. The dam will be 1400 ft. long.

TELEPHONE AND TELEGRAPH.

HERMOSA, BEACH, CAL.—The board of trustees has instructed the city attorney to draw up an ordinance advertising the sale of a telephone franchise.

SUNNYSIDE, WASH.—The Valley Telephone Co. has been incorporated for $50,000, by L. E. Harrington, E. F. Keyes, C. M. Keyes, M. H. Manuel, R. W. Manuel, A. M. Murfin.

RUPERT, WASH.—A deal has been closed whereby the local telephone system owned by Victor & Brown has been taken over by the Bell Telephone Company. Several improvements are contemplated by the new owners.

SUNNYSIDE, WASH.—Geo. Smith has received the contract for constructing the new Benton City telephone system. There will be about 24 miles of line to build. The new system will be conducted by the directors of the Sunnyside Irrigation District of Benton city.

PASCO, WASH.—The city council has received a report from the committee appointed to interview the Twin City Telephone Company to the effect that the management has promised to commence work inside of two weeks and to complete the system by July 1.

TOMBSTONE, ARIZ.—The telephone line of the Pluachuca Water Company will not be repaired for some time at least through Coronado Forest Reserve. The company will immediately rebuild the line to the foothills of Huachucas and up to the Miller Canyon reservoir, however.

STOCKTON, CAL.—Permanent organization of 19 farmers' telephone companies, connecting with the local exchange of the Pacific Telephone & Telegraph Company was effected at a meeting in Modesto recently in connection with the fight of the rural patrons against the raise in rates established about a month ago by the exchange company. Representatives of the 19 companies attended the meeting and elected officers headed by E. L. Routh as president, D. F. Conant, vice-president; M. P. Long, secretary, and John A. Orr as treasurer.

TRANSPORTATION.

EAST SAN DIEGO, CAL.—Application has been made to the trustees of East San Diego for a franchise to construct and operate a street railway for a period ending September 1, 1952. Sealed bids will be received for the proposed franchise up to March 6th.

MARTINEZ, CAL.—J. B. Dodgers of the Martinez & Concord Interurban Electric Railroad and Irving Peterson have made application for a franchise to build an electric line over the county road from Martinez city limits to a point north of Auto Inn, near Pacheo.

STOCKTON, CAL.—An agreement providing for the joint operation of their lines is announced by the Central California Traction and Tidewater Southern railroads. While each company is to preserve its identity, the agreement is said to be tantamount to a merger. The same ticket and freight offices will be used, and one dispatcher will handle all trains for both roads. Employees, it is understood, will be interchangeable.

WATERWORKS.

BAKER CITY, ORE.—The contract for $75,000 city water line extension bonds has been awarded to Henry Teal of Portland by the Baker commissioners.

ROUNDUP, MONT.—A contract for water main extension, involving an expenditure of more than $15,000, has been awarded to the Security Bridge Company.

SACRAMENTO, CAL.—The bid of Ambrose & Teichert for an addition to the city water works, at Front and I streets, has been accepted by the commission.

RUPERT, IDAHO.—An ordinance has been passed calling for an election February 29th to vote on $6000 worth of bonds for the construction of a municipal water system.

GREAT FALLS, MONT.—Taxpayers of Great Falls at the recent election authorized the issuance and sale of bonds in the sum of $150,000 for the construction of a filtration and water softening plant.

BOISE, IDAHO.—The commission has issued a certificate of convenience and necessity to the village of Roberts for the construction of a municipal water system. The village has bonded itself for $10,000.

SANTA ANA, CAL.—Four bids were received by the city trustees for a large quantity of water pipe for the water department. The bid of the U. C. Cast Iron Pipe & Foundry Company, of San Francisco, was accepted.

SEATTLE, WASH.—The construction of a sandpipe in the Bacon Hill District with a capacity of 300 gallons, together with the installation of a trunk main in the Rainier valley is contemplated by the water department.

HEMET, CAL.—Damage to the Lake Hemet Water Company as the result of floods will be more than $75,000. A great deal of flume line in the mountains has been washed away, and the remainder is damaged. Not only irrigation but the domestic water supply is cut off.

SANTA MONICA, CAL.—Petitions for a special election to again submit to voters the question of buying four local water plants for a municipal system will be circulated at once. The value of the plants is approximately $600,000. The allowance will be added for the connection of the four systems, making a total of $712,000 for the proposed bond issue.

PORTLAND, ORE.—Commissioner Daly has been directed by the council to proceed with the extension of the Bull Run distributing mains throughout the St. Johns District, duplicating the private system of the St. Johns Water Power & Lighting Company, and City Attorney LaRoche has been directed to prepare an ordinance authorizing the issuance of $125,000 of water bonds to provide funds for the project.

PORTLAND, ORE.—The contract for carrying out the proposed Suttle's Lake irrigation project at Grandview, Ore., estimated to cost $600,000, has been awarded to Henry J. Kaiser Company of Vancouver, B. C., and Everett, Wash., at cost plus 13½ per cent, the lowest bid. James Kennedy of Portland bid cost plus 15 per cent, and Hans Pederson of Seattle, bid cost plus 18 per cent. O. Laurgaard, Railway Exchange Building, prepared the plans.

SAN RAFAEL, CAL.—The state supreme court has issued an alternate writ of mandate directed to William Dodge, auditor of the Marin municipal water district, ordering him to countersign the $3,000,000 bonds of the district or else to appear in court on March 6 and show cause. Dodge refused to sign, on the grounds that the district under its present organization has not the constitutional right to issue and sell the bonds or to collect taxes for the payment of interest thereon.

FLAGSTAFF, ARIZ.—J. J. Reynolds of Chicago, chief engineer for the Joliet & Eastern Railroad Company, has been in consultation with C. H. Spencer relative to the work to be done on a big water development scheme of the Coconine Water Development & Stock Company, which proposes to develop sufficient water to furnish the Santa Fe, Grand Canyon and other places with water for stock purposes and irrigation. The company will start work on the project early next spring.

TRADE NOTES.

The Holtzer-Cabot Electric Company expects to occupy its new building at 125 Armory street, Boston, Mass., on and after February 22.

NEW CATALOGUES.

Condit Electrical Mfg. Co. of Boston, Mass., have issued a number of new bulletins on oil switches. Nos. 401, A, B and C tell of the protection of small induction motors (started without compensators) by the use of non-automatic, non-automatic with fuse terminals and automatic switches respectively. No. 410 illustrates and describes oil switches for pole line use and No. 411 for manhole installation.

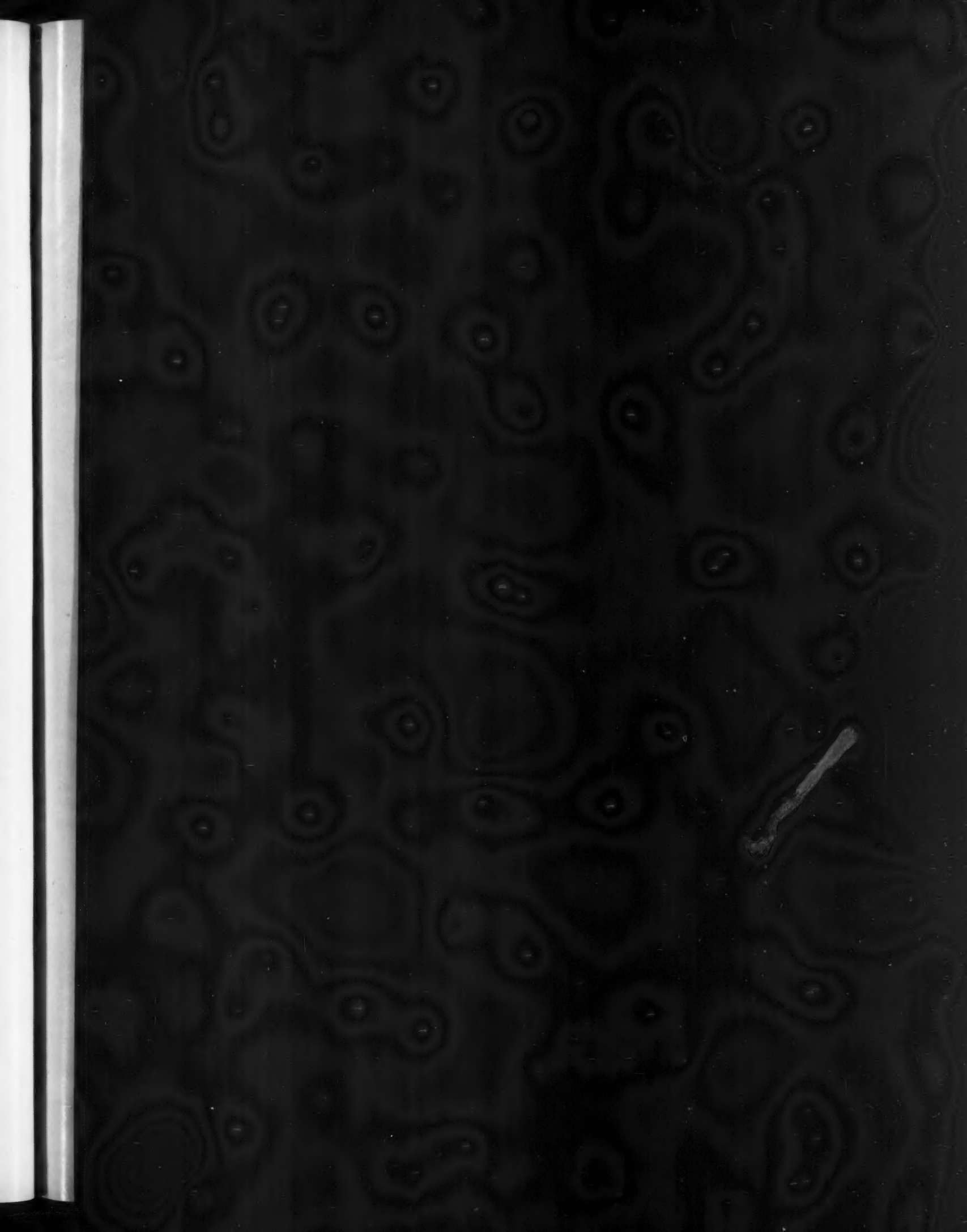
The General Electric Company has just issued Bulletin No. 48017 which refers to the application of electricity in the harvesting of natural ice. The bulletin is illustrated with views of various installations of motors for driving basin saws, field cutter, channel pusher, house ice cutter, and also shows the use of a motor-driven hoist in ice storage. There are also illustrations of various motors applicable to this work.

NEWS OF IDAHO PUBLIC SERVICE COMMISSION.

The Commission has granted a certificate of public convenience and necessity to the Paul Electric Co., Ltd., for the construction of an electric light and power system at Paul, Minidoka County, Idaho.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Commission has authorized the Western States Gas and Electric Company to withdraw $12,773.86 from the Girard Trust Company, being the amount spent for betterments from a trust fund of $182,000.

The San Joaquin Light and Power Corporation has filed with the Commission an application for authority to execute a supplemental mortgage to The Equitable Trust Company of New York, to place under its first and refunding mortgage the following subsidiaries to the San Joaquin corporation: The Selma Water Works, The Madera Water Works, The Madera Light and Power Company, The Lemoore Light and Power Corporation and The Bakersfield Gas and Electric Light Company.

The Commission has authorized the Northern California Power Company, Consolidated, to enter into an agreement with the holders of its $670,000 Series A debentures, dated Feb. 1, 1912, or more than three-fourths of the holders, providing a postponement of the maturing of these debentures from February 1, 1916, to February 1, 1920. The bonds are to bear interest at 6%, and the power company shall pay monthly $5000 on account of principal.